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THE VIADUCT AT THE FALLS OF ST. ANTHONY.

BY H. C. HOVEY.

When Father Hennepin, in July, 1680, came in sight of the cataract whose curling waters he named after his patron saint, he little realized the transformations that were to be made in the interests of commerce and manufacture. Natural changes have also taken place, by the recession of the falls, so that his glowing description would not now be recognized in its main particulars, although probably correct at the time. The hard Trenton limestone which underlies the district around St. Paul and Minneapolis forms the brink of the falls, resting, however, on a bed of white, friable, sandstone.

The washing away of this crumbling substance has of late years been so rapid as to threaten the degeneration of the cataract into a foaming rapid. The height has thus been reduced from the fifty or sixty feet given to it by Hennepin to thirty feet, as measured by Jonathan Carver a century later, and finally to fifteen feet in modern times. At an expense of nearly a million dollars, the Government came to the help of the millers, and in 1876 constructed an immense dike of concrete, to support the natural limestone ledge. This dike is four feet thick, thirty feet high, and 1,875 feet long. Canals have been cut to supply the great flouring mills that stand, like so many castles, on the bluffs overhanging the Mississippi River. By this means some of them now command a fall of fifty feet, and by better economy of the water privilege it is thought they might get a fall of seventy feet.

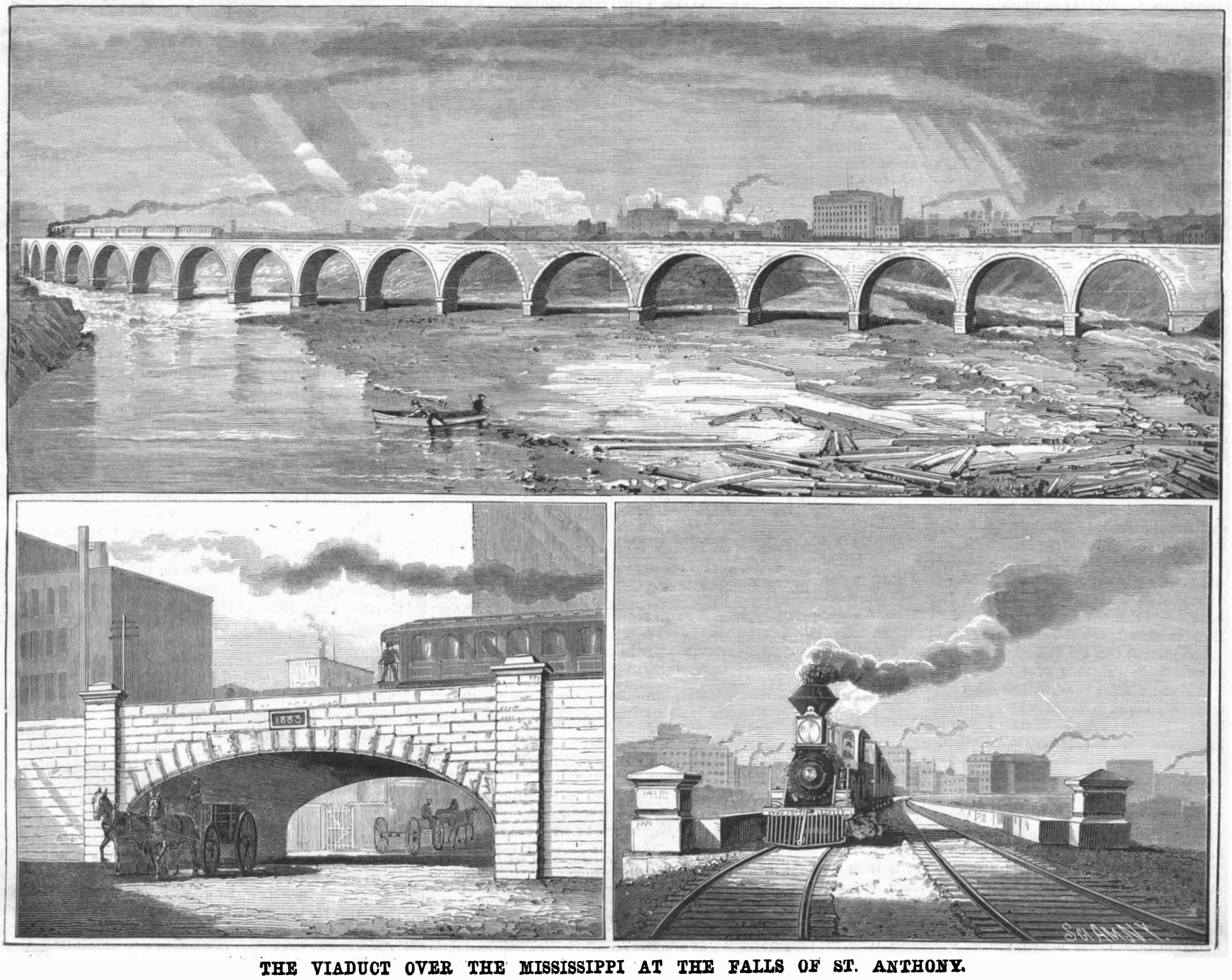
And now, spanning the whole assemblage of cascades, dikes, islands, canals, mills, and other objects of historical, scientific, and commercial interest, stretches, from bluff to bluff, the noble viaduct which it is my intention to describe.

The urgent necessity for some such structure became evident more than three years ago, or about the time when Minnesota entered on its new era of extraordinary prosperity. Nineteen railroads now send out from Minneapolis over one hundred passenger trains daily; and more than 230,000 car loads of freight were shipped from here last year. The daily grist of the flour mills is enough to fill a train a mile long. Such an immense traffic demands corresponding facilities. Hence, although two of the railroads had already built bridges of their own, one below Meeker Island, and the other at Nicollet Island, the associated roads decided to build this viaduct, and also a grand union depot, to which all the roads should, by the charter of the Union Company, have equal rights and privileges. The estimated expense of this great work was $3,000,000, which large sum was guaranteed by the Manitoba Railroad, under whose auspices it was begun and carried on.

Several plans were suggested, but the one adopted was that offered by Col. Charles C. Smith, chief engineer of the Manitoba Railroad, who also advised that the most durable materials obtainable should be used. Accordingly the piers, whose foundations rest on the ledges forming the river bed, are built of the gray St. Cloud granite, which is extremely hard and enduring. The material used above the springing line, which is four feet above the high water mark, is the magnesian limestone, known as Kasota stone, and that hardens by exposure to the atmosphere. There are 30,554 cubic yards of solid masonry and 18,000 cubic yards of stone filling, chiefly the common blue limestone from the local quarries in the vicinity.

The viaduct crosses the river below the Falls, partly in order that the piers might have a more solid foundation than could be readily secured above; and also—a fact to be appreciated by the traveling public—in order to enable tourists to enjoy the remarkably fine view, which is much better from below than from above. The total height of the structure is 82 feet, and the height above high water is 65 feet. The top is 38 feet wide, giving room for a double, stone ballasted track, which is guarded by a strong stone coping. About 800 feet of the viaduct are built on a curve of six degrees, of 966 feet radius, at its west end; the object of this curved diagonal being to exempt it as much as possible from danger by reason of the masses of ice that tumble over the Falls during the spring floods. Besides the iron bridge near the depot, there are 23 stone arches, resting on granite piers rising from the bed of the river. Four of these spans measure 100 feet each, sixteen measure 80 feet each, and three but 40 feet each; and the total length of the viaduct is 2,100 feet, making it one of the longest structures of the kind in the world. The cost of the stone portion is $650,000, to which may be added $50,000 for the iron terminal bridge, making a total of $700,000. This does not include the approaches nor the right of way, which must add considerably to the expense, as the western terminus is among the mills, as represented in one of the accompanying cuts. The eastern approach is through more open ground, crossing the campus of the University of Minnesota, and following the bluff line along the river.

Work was begun on the viaduct in February, 1881, and it was completed November 22, 1883, without any special demonstration, beyond the crossing of a single train with the officials of the railroad and a few invited guests. After having crossed, these gentlemen then walked back to the center of the bridge, while the engine was driven past them at a speed of twenty miles an hour, as a partial test of the firmness of the structure. The ends of the viadact were then fenced up, and no further tests will be made nor any crossings allowed until next summer, when the union depot hav-



THE VIADUCT OVER THE MISSISSIPPI AT THE FALLS OF ST. ANTHONY.

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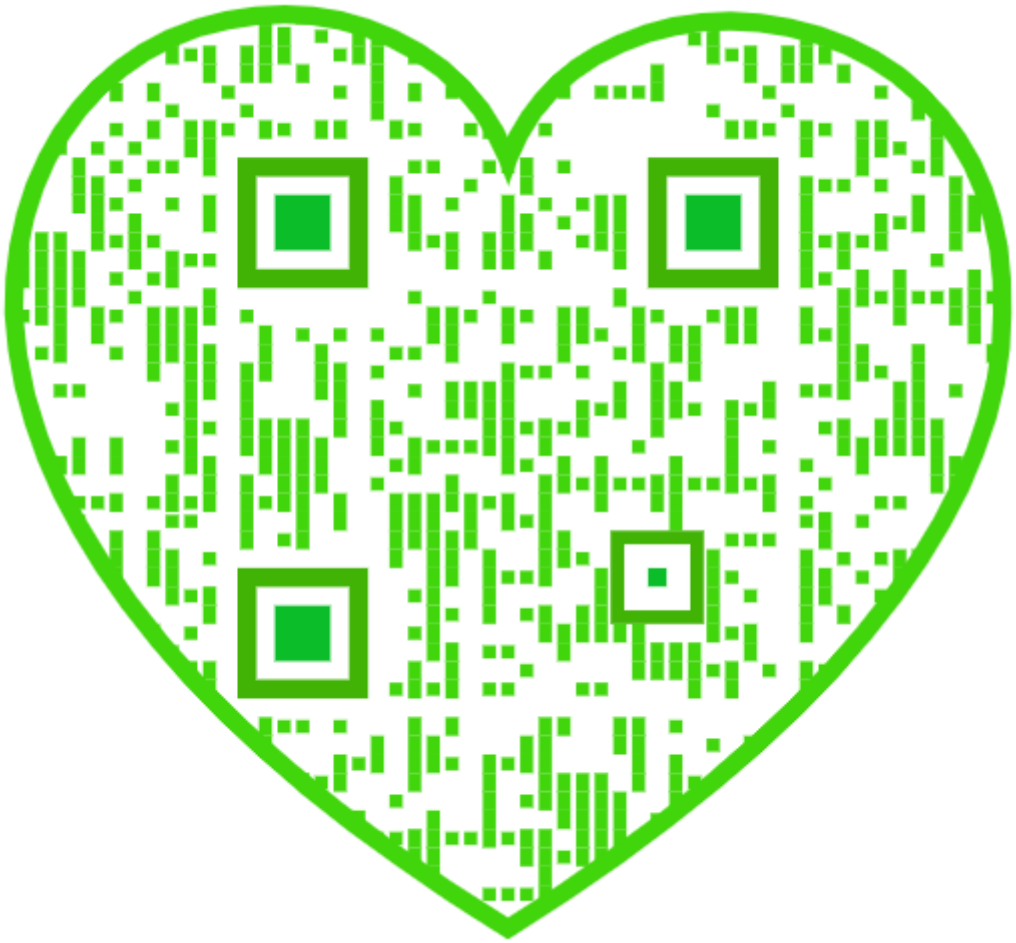

ing been completed, both will be thrown open to the general traffic as agreed. It should be added that the union depot will stand on the western bank adjacent to the elegant suspension bridge now joining together the two halves of Minneapolis, and of which its citizens are so justly proud. It will be arranged so that most of the tracks will run under the streets, instead of crossing at grade, with the exception of those that may still run to the several depots now in use. When these improvements shall have been completed, in the near future, it is doubtful if any other city can boast of finer approaches than these, or that will give strangers, on their arrival, a more favorable impression as to the attractions and commercial importance of the locality.

Simple Home Remedies.

The following remedies for many simple ailments we find recommended in *Hall's Journal of Health*. And while the remedies may not be new to many of our readers, they will be found useful to all. We now publish them that they may be at hand for ready reference.

Half a teaspoonful of common table salt dissolved in a little cold water and drank will instantly relieve "heart burn" or dyspepsia. If taken every morning before breakfast, increasing the quantity gradually to a teaspoonful of salt and a tumbler of water, it will in a few days cure any ordinary case of dyspepsia, if at the same time due attention is paid to the diet. There is no better remedy than the above for constipation. As a gargle for sore throat it is equal to chlorate of potash and is entirely safe. It may be used as often as desired, and if a little is swallowed each time, it will have a beneficial effect on the throat by cleansing it and allaying the irritation. In doses of one to four teaspoonfuls in half a pint to a pint of tepid water it acts promptly as an emetic, and, in cases of poisoning, is always on hand. It is an excellent remedy for bites and stings of insects. It is a valuable astringent in hemorrhages, particularly for bleeding after the extracting of teeth. It has both cleansing and healing properties, and is therefore a most excellent application for superficial ulcerations. Mustard is another valuable remedy. No family should be without it. Two or three teaspoonfuls of ground mustard stirred into half a pint of water acts as an emetic very promptly, and is milder and easier to take than salt and water. Equal parts of ground mustard and flour or meal made into a paste with warm water and spread on a thin piece of muslin, with another piece of muslin laid over it, forms the indispensable "mustard plaster." It is almost a specific for colic when applied for a few minutes over the "pit of the stomach." For all internal pains and congestions there is no remedy of such general utility. It acts as a counter-irritant by drawing the blood to the surface; hence in severe cases of croup a small mustard plaster should be applied to the back of the child's neck. The same treatment will relieve almost any case of headache. A mustard plaster should be moved about over the spot to be acted upon, for if left in one place it is liable to blister. A mustard plaster acts as well when at considerable distance from the affected part. An excellent substitute for mustard plasters is what is known as "mustard leaves." They come a dozen in a box, and are about four by five inches. They are perfectly dry, and will keep for a long time. For use it is only necessary to dip one in a dish of water for a minute and then apply it. Common baking soda is the best of all remedies in cases of scalds and burns. It may be used on the surface of the burned place either dry or wet. When applied promptly, the sense of relief is magical. It seems to withdraw the heat and with it the pain, and the healing process soon commences. It is the best application for eruptions caused by poisonous ivy and other poisonous plants, as also for bites and stings of insects. Owing to colds, over-fatigue, anxiety, and various other causes, the urine is often scanty, highly colored, and more or less loaded with phosphates which settle to the bottom of the vessel on cooling. As much soda as can be dipped up with a ten cent piece, dissolved in half a glass of cold water and drank every three hours, will soon remedy the trouble.

A Diamond Mine in Wisconsin.

A dispatch from Milwaukee lately announced that great excitement prevailed at Eagle, a small place in Waukesha County, over the discovery of a rich diamond "find" in that village. It seems that a lady had brought a large bright stone to the city and sold it to a jeweler for $1, and which turned out to be a rough diamond worth $800. The dispatch further says that parties have purchased all the land about Eagle at large figures and are making investigations.

Accepting as true the finding of the diamond, to conclude therefrom the existence of a diamond field is decidedly hazardous; diamonds as well as other precious stones are frequently found in places where a diligent search fails to bring other specimens to light, and we would advise intending "investors" to exercise some caution.

Test for Glue.

The following simple and easy test for glue is given in the *Tischler Zeitung:* A weighed piece of glue (say one-third of an ounce) is suspended in water for twenty-four hours, the temperature of which is not above 50° Fahr. The coloring material sinks, and the glue swells from the absorption of water. The glue is then taken out and weighed; the greater the increase in weight the better the glue. If it then be dried perfectly and weighed again, the weight of the coloring matter can be calculated from the difference between this and the original weight.

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NEW YORK, SATURDAY, MARCH 15, 1884.

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AMERICA A HUGE "JELLY FISH."

Rear-Admiral Rogers, in a letter read in the U. S. Senate February 28, makes the above comparison. He says we have not a single breech-loading gun in any of our ships nor upon any of our forts, nor can we make one of more than six inches caliber in the country. Therefore, with our 7,000 miles of seacoast, we make a very prominent mark, but would be powerless to strike back if assailed. The letter was brought out by the proposition to build seven new steel cruisers, which has passed the Senate. It provides for one cruiser of 4,500 tons; one of 3,000 tons; a dispatch vessel of 1,500 tons; two heavily armed gunboats of 1,500 tons; one gunboat of 750 tons, and one of 900 tons; a steel ram; a cruising torpedo boat, and two harbor torpedo boats.

The cost of these seven cruisers, with the four ordered in 1882, of which the Chicago is the most prominent, and the completion of the double-turreted monitors, will be less than that of two of the first-class iron-clads of England or Italy. While our Government is thus proceeding with such close economy, England, France, and Germany are steadily enlarging their gunmaking and steel shipbuilding facilities, and Krupp is now constructing a gigantic steam hammer, to cost $2,500,000.

If it were entirely clear in what direction the nation could with the most wisdom proceed for the efficient strengthening of the navy, there can be little doubt but that the public sentiment would not only sanction a much larger expenditure than the completion of these new cruisers calls for, but would earnestly impose upon Congress the duty of prompt action. As it is, however, the cruisers now under way have been so severely criticised as to awaken a feeling of public distrust concerning the advisability of proceeding further in the same way. The vessels now building were said to be only experimental, but the question arises whether the new ones in contemplation are also of the same character, and, if so, whether we need have so many experiments under way at the same time.

VALUE OF INVENTIONS TO THE WORLD.

While the time-servers and place-seekers, who now constitute the majority in our national Congress, are seeking in every way to destroy the value of patent rights, and to take away the material incentives to invention afforded by the Constitution and by former statutes, it may be well to call the public attention to a pregnant paragraph written by Lord Bacon two hundred and fifty years ago. If it was almost prophetic then, there is no man of intelligence now living who can fail to see how wonderfully the truth of its every word has been realized:

"The introduction of great inventions appears to hold by far the first place among human actions, and it was considered so in former ages; for to the authors of inventions they awarded divine honors, but only heroic honors to those who did good service in the State (such as the founders of cities and empires, legislators, deliverers of their country from long endured misfortunes, quellers of tyrannies, and the like). And certainly, if any one rightly compare the two, he will find that this judgment of antiquity was just, for the benefits of inventions may extend to the whole race of man, but civil benefits only to particular places; the latter, moreover, last not beyond a few ages, the former forever. The reformation of the State in civil matters is seldom brought about without violence and confusion, while inventions carry blessings with them, and confer benefits without causing harm or sorrow to any."

PROGRESS IN EXACTNESS.

Since the introduction of absolute fixed gauges of exact sizes into the machine shop, in place of the universal calipers, there has been a steady improvement in the quality of work, particularly of machine tools. Accompanying this improvement there has unquestionably been another—that of the workman. Both are evidences of progress in the right direction; the use of straight edges, surface plates, solid hardened steel gauges, rings for external and plugs for internal diameter measuring, end measure pieces, and thread gauges demand the practice of exactness on the part of the workman and tend to insure exactness in the result of his work.

But the machine tools themselves have been faulty in the most vital parts. Probably there are very few lathes in use which have perfect leading screws, and if this is so the proportion of planers which have twin elevating screws alike is much less. Reference to this lack of exactness and to its probable remedy was made in these columns (date of December 8, 1883, page 352), but since then the enterprise—advertised in succeeding numbers—has grown by the demands upon it, so that an enlargement to more than double its initial capacity has to be immediately made, within four months of its beginning. The reason is that the closest mathematical calculation is allied with the employment of the most scientific means and the use of the best tools to produce results. Four establishments, representing the most advanced stages of improved machinist practice in this country, have sent in orders for lathe leading screws and planer elevating screws to such an amount as to require a very great enlargement of facilities.

This statement shows how needful was the want which is thus supplied; our best machinery was faulty. It has been scarcely possible to make a screw of any pitch, coarse or fine, that for twenty-four inches would preserve its integrity of pitch; the variations from the true standard being at times so great as almost to produce a fractional thread.

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Under such circumstances, it was not possible to do exact work on the lathe or planer, and the after-services, of the surface plate and straight edge, guided by human skill, were necessary to secure a good job. On the planer, especially, the requirement of exact threaded screws was noticed. It is difficult on the best of planers to plane a piece with two really parallel surfaces, if those surfaces are wide enough to be tested by straight edges and end measure pieces combined; the elevating screws at each end of the head rarely agree. Possibly this lack of absolute uniformity in the two screws at each side of the crosshead is the reason why the planer cannot be made to do work both ways with roughing and finishing cut, the two ends of the crosshead on both sides of the planer not working together. If the production of exact screws can aid in this improvement, and add at least thirty-three per cent to the profitable work of the planer, it will be a point of much value gained. That this improvement in the exactness of machine tools of precision is possible, and that it can be accomplished by present practical means, is indicated by the fact that several of our best known tool builders are availing themselves of the advantages of the new system.

DECISIONS RELATING TO PATENTS.

BEFORE THE COMMISSIONER OF PATENTS.

EX-PARTE MARSHALL.

Butterworth, Commissioner:

Appeal from the Examiners-in-Chief.

Considered as a generic term, a combination may be defined to be a co-ordination of individual functions, so as to constitute a common function. Co-ordination necessarily implies some modification of the individual function of each part as it existed prior to the combination.

To be patentable a combination must conform to the requirements of the definition given above, and must also contain two other elements—namely, novelty and utility.

A shoe containing the ordinary front lacing and the common elastic web in its side presents a mere aggregation of old features, and not a patentable combination.

PROSPECTS OF THE PATENT BILLS.

The hostile patent bills that have passed the House and other bills now before the Senate have not yet been reached. Meantime hundreds of letters and remonstrances against the passage of these bills have been sent by individuals in all parts of the country, and hundreds more will soon be sent forward. If the friends of the patent laws continue to pour in their protests for a short time longer, it is believed this mischievous legislation may be postponed and at last defeated. Nothing has a more powerful influence with Senators and Representatives than forcible letters from their own townsmen and constituents. We therefore urge upon inventors, manufacturers, and all who wish to uphold the industries of the nation to write directly to Senators, and give reasons why these bills should be set aside. Legislators need to understand the views and feelings of the people they represent, and then they will speak and act accordingly.

No person should defer his protest in the hope that others will do something or that some combined movement will take place. Let each individual promptly organize himself into an association of one, and send forward his arguments, resolves, and letters, without hesitation or delay.

For the convenience of readers we here repeat the numbers and general nature of some of the bills now before the Senate.

House bill 3,925, introduced by Hon. Mr. Calkins, of Indiana, provides substantially that if the inventor or owner of a patent shall dare to attempt to sustain his rights by bringing a suit against infringers, he shall recover no costs, and shall pay to the infringer's lawyer a counsel fee of $50. This bill was passed in the House of Representatives by an enormous majority, on January 21, and is now before the Senate for concurrence. The members who voted for it apparently regard it as a very upright proceeding to encourage the inventor to reveal his invention by passing laws to give him a patent, and then passing other laws to deprive him of the benefit of said patent. This is the way Congress exemplifies integrity and fair dealing before the people.

House bill 3,934, introduced by Mr. Vance of N. C., provides substantially that any person may use any patented article he pleases without liability, but shall become liable after receiving notice that a patent exists; and may then require the patentee to give him the use of the patent for a royalty to be named by the courts, thus robbing the patentee in the first instance and then depriving him of the control of his patent. This bill was passed by the House, January 22, 1884, by a vote of 114 ayes to 6 noes.

The texts of the foregoing bills will be found on page 73 of the SCIENTIFIC AMERICAN for Feb. 2.

House bill 3,617, introduced by Mr. Anderson, of Kansas, reduces the lifetime of a patent from 17 years to 5 years. Not yet passed, but perhaps soon will be by a great majority, as there is no member in the House who has so far ventured to say a word in protest or speak in favor of inventors or the present patent system.

In the Senate the bill introduced by Mr. Voorhees, of Indiana (S. 1,558), provides in effect that all patents shall be free to the public. This bill caps the climax; it has not yet passed; but soon will be if the members of the Senate share in the views of the House majority.

The following is the text of Senator Voorhees' bill:

S. 1,558. "*Be it enacted, etc.*—That it shall be a valid defense to any action for an infringement of any patent, or any suit or proceeding to enjoin any person from the use of a patented article, that the defendant therein, or his assignor, purchased the patented article for use or consumption, and not for sale or exchange, in good faith and in the usual course of trade, without notice that the same was covered by a patent, or without notice that the seller had no right to sell such article; and in all such cases notice received after such purchase shall not have the effect to impair in any way the right of such purchaser as absolute owner."

The following are the names of members of the Senate and the States they represent:

ALABAMA.
James L. Pugh..... Eufaula.
John T. Morgan.....Selma.

ARKANSAS.
James D. Walker.....Fayetteville.
Augustus H. Garland..Little Rock.

CALIFORNIA.
James T. Farley.....Jackson.
John F. Miller.....S.Francisco.

COLORADO.
Nathaniel P. Hill... ..Denver.
Thomas M. Bowen... Del Norte.

CONNECTICUT.
Orville H. Platt.....Meriden.
Joseph R. Hawley.....Hartford.

DELAWARE.
Thos. Francis Bayard..Wilmington.
Eli Saulsbury.....Dover.

FLORIDA.
Wilkinson Call.....Jacksonville
Charles W. Jones.....Pensacola.

GEORGIA.
Joseph E. Brown.....Atlanta.
Alfred H. Colquitt.....Atlanta.

ILLINOIS.
John A. Logan.....Chicago.
Shelby M. Cullom.....Springfield.

INDIANA.
Daniel W. Voorhees...Terre Haute.
Benjamin Harrison. ..Indianapolis

IOWA.
William B. Allison.....Dubuque.
James F. Wilson. .....Fairfield.

KANSAS.
John J. Ingalls.... ...Atchison.
Preston B. Plumb.....Emporia.

KENTUCKY.
John S. Williams... ..Mt. Sterling
James B. Beck.....Lexington.

LOUISIANA.
Benjamin F. Jonas.....N. Orleans.
Randall L. Gibson.....N. Orleans.

MAINE.
Eugene Hale .....Ellsworth.
William P. Frye.....Lewiston.

MARYLAND.
James B. Groome.....Elkton.
Arthur P. Gorman.....Laurel.

MASSACHUSETTS.
Henry L Dawes.....Pittsfield.
George F. Hoar.... ....Worcester.

MICHIGAN.
Omar D. Conger.....Port Huron.
Thomas W. Palmer..Detroit.

MINNESOTA.
Sam'l J.R.McMillan..St. Paul.
Dwight M. Sabin.....Stillwater.

MISSISSIPPI.
James Z. George.....Jackson.
Lucius Q. C. Lamar...Oxford.

MISSOURI.
George G. Vest... ...Kansas City.
Francis M. Cockrell..Warrensburg.

NEBRASKA.
Charles H.Van Wyck.Neb'ka City.
Charles F.Manderson.Omaha.

NEVADA.
John P. Jones.....Gold Hill.
James G. Fair.....Virginia City.

NEW HAMPSHIRE.
Henry W. Blair .....Plymouth.
Austin F. Pike.....Franklin.

NEW JERSEY.
William J. Sewell....Camden.
John R. McPherson..Jersey City.

NEW YORK.
Elbridge G Lapham..Canandaig'a.
Warner Miller.....Herkimer.

NORTH CAROLINA.
Zebulon B. Vance....Charlotte.
Matt W. Ransom.....Weldon.

OHIO.
George H. Pendleton.Cincinnati.
John Sherman..... Mansfield.

OREGON.
James H. Slater.....Le Grande.
Joseph N. Dolph.....Portland.

PENNSYLVANIA.
J. Donald Cameron..Harrisburg.
John I. Mitchell.....Wellsboro.

RHODE ISLAND.
Nelson W. Aldrich...Providence.
Henry B. Anthony...Providence.

SOUTH CAROLINA.
Wade Hampton.....Columbia.
Matthew C. Butler....Edgefield.

TENNESSEE.
Howell E. Jackson...Jackson.
Isham G. Harris.....Memphis.

TEXAS.
Sam Bell Maxey.....Paris.
Richard Coke.....Waco.

VERMONT.
Justin S. Morrill. ....Strafford.
George F. Edmunds..Burlington.

VIRGINIA.
William Mahone.....Petersburg.
H H.Riddleberger....Woodstock.

WEST VIRGINIA.
Johnson N. Camden....Parkersb'g.
John E. Kenna.....Kanawha.

WISCONSIN.
Angus Cameron.. .....La Crosse.
Philetus Sawyer .. ....Oshkosh.

PATENTS AND POLITICS.

It is estimated that between 30,000 and 40,000 citizens of the State of New York have received patents for their inventions which remain unexpired. Nearly every manufacturer in the State is an owner, or is interested in or works under some patent. It is probable that at least 100,000 voters in New York State are directly connected with industries that will be greatly damaged if these bad patent laws are passed. The majority that carries the State in the approaching election will not probably be very large. Which of the two great parties will sweep the State?

Certainly it will not be the party whose senators and representatives in Congress are doing all they can to destroy the interests of their constituents at home. What is true of New York is true of several other States. The inventors and manufacturers of the country will have power enough in the coming elections to determine upon which side the victory shall rest; and that power is likely to be exercised. A little ingenuity, a little determined and united effort, will do the business.

THE TRIPLE THERMIC MOTOR.

A very neat example of the bisulphide of carbon engine has lately been brought to this city for private exhibition to capitalists and others who may wish to purchase shares therein. It is styled the "Triple Thermic Motor." The engine is located at No. 651 West 45th St. The motor consists of a steam boiler, a bisulphide of carbon vessel, an ordinary steam engine, a surface condenser, and pumps. The steam from the boiler warms the bisulphide of carbon and converts it into vapor which drives the engine; the exhaust vapor then passes through the condenser, where it is liquefied and is returned by pump to its vessel to be reheated, and go the rounds again.

Greater care seems to have been taken in this machine to prevent loss of energy than was shown in some of the former bisulphide of carbon engines. For example, in this new motor the pipes, engine cylinder, piston rod, etc., are carefully jacketed, and every precaution taken to prevent the loss of heat or escape of the vapor; the latter precaution is rather necessary, as it yields an odor of the decayed egg class.

The mechanical execution of the engine and its parts is very creditable to the parties concerned, since its performances are nearly if not quite equal to those of a first class steam engine of the same horse power.

The engine is believed to yield thirty horse power, being about the same as would be obtained from a good steam engine and ordinary boiler of same sizes.

The engine is made under the patents of Mr. Thomas Colwell, of Chicago, Ill. One of his many patent claims is substantially as follows: "A motor for operating machinery, consisting of bisulphide of carbon, water, and plumbago." The addition of water and plumbago seems to be a new feature in this class of engines.

Some very exaggerated reports have been published in regard to the performances of this motor. For example, it has been stated that the steam from the boiler only had a value of fifteen horse power, while the engine yielded sixty-five horse power, the gain of power being due to the bisulphide of carbon. Such absurd statements savor of stock jobbing, and their circulation is to be regretted; probably they are not put forth by any one directly connected with the company.

Those who care to look into the theory of the bisulphide of carbon and analogous motors will find the subject discussed in the back volumes of the SCIENTIFIC AMERICAN. The following is from an article in our paper of Sept. 28, 1872, when the Ellis binary engine was under trial and discussion:

"Could an absolutely perfect binary vapor engine be constructed, its performance would exhibit precisely the same economy of fuel as would a perfect steam engine working between the same limits of temperature. There is, therefore, no purely scientific reason for anticipating economical advantage from this form of prime mover.

"There are, however, some practical considerations which would at least make it appear possible that the introduction of this form of engine may ultimately occur as a consequence of a superiority in economy over even the best of modern engines. It is evident that a wasteful steam engine may be converted into an economical binary engine, in which a large amount of the heat, formerly wasted, may be successfully utilized; and, in all non-condensing steam engines, some considerable proportion of the heat of the exhaust steam may be saved by such a change. Could the additional engine be constructed and operated at a moderate expense, it seems very certain that the binary plan would, in very many cases, be certainly advisable. Even with the best of condensing steam engines, it is by no means certain that the heat abstracted in the condenser might not be more economically removed and made useful by a fluid whose vapor has a higher tension than that of water at the same temperature."

Progress of Soap Fat Butter.

A committee of the Senate of the State of New York has been engaged lately in the investigation of the bogus butter business, with a view to ascertain its nature, extent, and best probable mode of regulation.

Out of thirty specimens of butter sold by as many respectable grocers, analysis showed that only ten were composed of real butter; all the rest were chiefly composed of lard. The price charged for the soap fat butter was about twenty-five cents per pound—the real butter selling for about the same.

Dr. Love, the chemist, testified that he could not distinguish the spurious butter from the genuine so as to swear to it, by its outward appearance, but he had no doubt of the accuracy of his chemical analysis. He said that in the manufacture of butterine and oleomargarine no chemical change takes place, but simply a mechanical mixture, and that all the substances used in the mixture have the same properties after the mixture as before, so that the lard, fat, and oils used in the bogus butter are no more injurious to health in the bogus butter than out of it. He had found no traces of nitric acid in his analysis, and would have noticed it if it had been present. He was of opinion that impure substances could be deodorized, so that they could not be distinguished. Even dead animals could be so deodorized, but if diseased germs were not destroyed they would prove deleterious to health. He knew of nothing in the process of manufacture of bogus butter that would be likely to kill disease germs. He could not say that he knew of an authentic case of injury to health by eating the bogus butter.

LARD CHEESE.

Mr. Martin gave the committee the results of his explorations in a manufactory of Neufchatel cheese, at Chester. He said that Mr. Durland informed him that one and a half pounds of lard mixed with one hundred pounds of skim milk was the mixture used.

Weather Signals.

A Florida correspondent suggests that the Government supply telegraph, railroad, and steamboat companies with flags and lanterns suitable to indicate by day or night the different features of the weather bulletins, and require their display accordingly as the reports are telegraphed over the country. We hardly see on what ground the Government could insist on the signals being so displayed, although it supplies the daily reports to all who care to take them. One of the trunk railroads has, however, shown the enterprise to adopt a system somewhat such as suggested, greatly to the satisfaction of the country people along its line.

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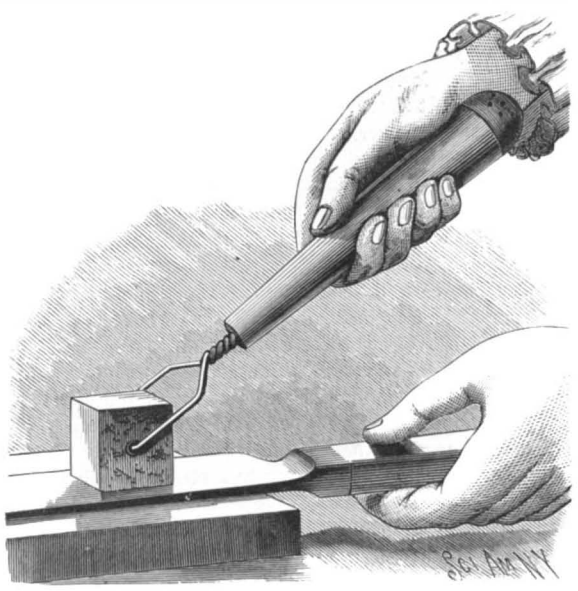
IMPROVED KNIFE SCOURER.

The engraving represents a device, recently patented by Mr. Charles A. Bryant, of Wakefield, Mass., for scouring and cleaning knives, cutlery, and other articles. The hollow handle is closed at the bottom, and is provided at its upper end with an apertured cap. In the lower end of the handle the stem of a wire frame is secured, on the cross piece of which a block of cork or rubber is hung. The cleaning or polishing powder is held in the hollow handle. A quantity of this powder is sprinkled from the cap upon the article to be cleaned, and is rubbed on the article by means of the block. The handle can be held at any desired angle to the blade, thus enabling a greater pressure to be exerted on the



BRYANT'S IMPROVED KNIFE SCOURER.

block than when it is held securely on the lower end of the handle. All four faces of the block can be used successively.

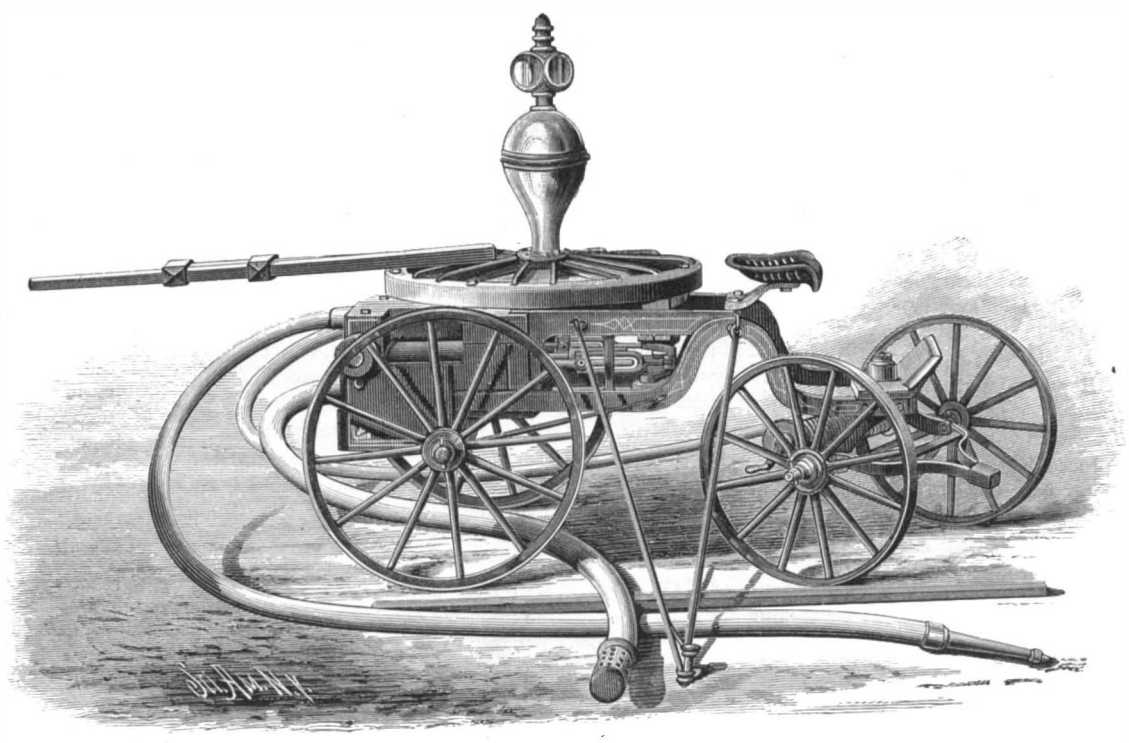
THE REMINGTON HORSE POWER FIRE ENGINE.

The accompanying illustration represents a fire engine that combines the merits of both the hand and steam apparatus. It is so planned as to be light and simple in construction while permitting great strength in the working parts, which are disposed so as to utilize all the power and yet be as free from wear as possible. It is mounted on four wheels for transportation, and may be drawn by men or horses. It is made entirely of metal, with the exception of the levers, and weighs about 3,000 pounds. It is a sweep power, the driving wheel being placed horizontally on top, and being furnished with eight sockets for levers, all of which may be used when it is necessary to work by men, and one or two when horses are available. There are three double acting pumps, driven by pinions which mesh into teeth on the driving wheel, and so arranged that their combined action produces a continuous pressure and even flow of water. The pump cylinders are 5¾ inches in diameter, with a stroke of 8 inches, and have a capacity of 200 gallons per minute. The horses travel in a convenient circle, at the ordinary walk of a work team, the draught being about the same as in plowing. All wearing surfaces exposed to the action of friction and water are made of hardened polished brass, so that neglect will not injure them, and the engine will always be ready for instant use. When in operation the engine is held in position by iron braces on each side, fastened to the ground by steel pins.

When operated by one pair of horses, going at a speed that can easily be maintained, it will force a stream from 115 to 160 feet horizontally through a ⅞ inch nozzle, or two streams through ¾ inch nozzles nearly the same distance. The engine can be worked by men in an alleyway six feet wide, as a motion of two or three feet forward and backward will force a stream through the hose nearly as well as a continuous motion.

The engine is especially designed for suburbs of cities, towns, factories, and isolated residences, and is successfully used for pumping out pits and mines and elevating water.

Further particulars can be obtained by addressing the manufacturers, the Remington Agricultural Company, of Ilion, N. Y., or 118 Chambers Street, New York city.



THE REMINGTON HORSE POWER FIRE ENGINE.

Cold rain water and soap will remove machine grease from washing fabrics.

New York Department of Public Works.

The report of the commissioner of this department for 1883 has just been issued. The rainfall in the Croton watershed was $42\frac{48}{100}$ inches, which is 4¾ inches less than the average for the past ten years. There are now more than 547 miles of pipes, 5,743 stop cocks, and 7,152 fire hydrants in the distributing system. Out of 25,201 inspections made last year, there were reported 1,770 cases of leaks from defective plumbing, and 1,614 places where water was wasted between midnight and six o'clock in the morning, at the rate of from one to five gallons per minute. During the year 2,195 meters were placed, making a total of 9,012 in use.

The present area of paved streets south of Harlem River is 7,457,800 square yards, and their length is $357\frac{47}{100}$ miles. The present extent of underground structures in the streets south of Harlem River is as follows: Water pipes, 547 miles; sewers, 398 miles; gas pipes, 857 miles; steam pipes, 16 miles; electric wires, 17 miles; telegraph wires, $3\frac{56}{100}$ miles; pneumatic tubes, ¾ of a mile, making a total of 1,839 miles. At the close of the year there were 24,412 gas lamps and 128 electric lights in use in the streets and parks of the city. The total revenue collected by the department was $2,029,335.74, of which $1,869,518.96 was from Croton water rents and permits.

Cable Railroads in New York.

It has been decided by the commission appointed to employ the system of cable propulsion to surface railroads in New York city. The *Herald* prints an interview with General Viele, who examined the system in use in Chicago, and he expressed himself as satisfied with its practicability, stating that there were no defects, either apparent or real, to be discovered in the service.

A correspondent of the same paper, however, expresses a doubt whether the system as used in Chicago would be equally efficient in New York, and in view of the importance of the question, his views demand consideration. His first objection is raised against the speed of the cable, which cannot be graduated to necessary conditions of street traffic, but must move at the speed established by the machinery at the source of power. In case of delay no lost time can be made up by the leading car, since all travel at the same speed; hence, in streets given over to other traffic which might cause delay, rapid transit is out of the question. Besides this, the movement being entirely dependent upon one source of power—the traveling cable—any mishap or derangement would cause the entire suspension of traffic.

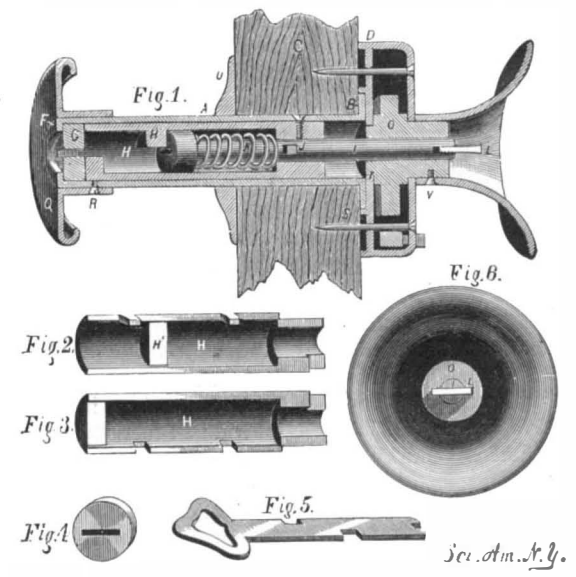
Objection is also raised to the trouble occasioned by curves and switches, which up to the present time has not been entirely obviated even in Chicago. The construction of the roadbed and cableway also deserves notice. In the Chicago system a trench has been dug about four feet deep and nearly as wide at the top, which is continuous between each pair of rails or tracks, the inner surface laid in broken stone and cement, in which are placed the iron yokes, frames, and wheels upon which the rope moves. This permanent trench—it is, in fact, an auxiliary sewer—has manholes at frequent intervals, and must be accessible at all times for purposes of inspection, lubrication, and repair of rope and supports, and is always open by its slotway to the surface. This arrangement is possible on a street as wide as State Street, Chicago, which is very wide, but it is impossible with the complicated underground conditions of the narrow streets of New York. During its construction it obstructs the street seriously, and permanently occupies space needed for other important uses.

That there is still room for many improvements, the above amply shows, and the adoption in any city of a system which does not provide for all contingencies and smooth working, would be a costly and unsuccessful undertaking.

IMPROVED LOCK AND LATCH.

The engravings represent an invention recently patented by Mr. H. H. Freeman, of Milton, Ontario, Canada. The spindle, A, is hollow, circular in form, and has a flange, B, which rests against the face of the door when the spindle is passed into the bore, in which it fits loosely for axial rotation. The outer end of the spindle is apertured to leave the annular shoulder, F, against which the loose revolving key plate, G, may rest. The casing, H, is made in two parts—shown in Figs. 2 and 3—and may be provided with any suitable number and form of wards for the flat key.

In one end of the casing, arranged diametrically opposite each other, are two notches, one of which is deeper than the



FREEMAN'S IMPROVED LOCK AND LATCH.

other. On the side edges of the two parts are formed lugs and notches for the purpose of keeping the wards and end notches in proper relative position with each other when the casing is slipped into the spindle, A. The casing is held to the spindle by a screw. The bar, I, is formed with a head slotted to receive the end of the key, and also has a projecting pin, J, to engage the end notches of the casing, and a bit, L, at the inner end. The bit has side shoulders for engaging notches, formed in the hub, O, which extend through the hub to allow the bit to pass through in adjusting the lock to the door. A spring on the bar, I, acts against the head of the bar and shoulders on the casing, to throw the bar out in order to keep the pin, J, and bit, L, engaged with their respective notches; when the pin is in the deep notch the bit will engage with the notch in the hub, but when the pin is in the shallow notch the bit will be disengaged. The knob, Q, spindle, casing, and bar turn together axially. The inside knob is fixed to the hub by a screw so that the door may always be unlocked from the inside. As shown in Fig. 1, the stud, J, rests in the deep notch of the casing, and the bit, L, is engaged with the hub, so that the latch bolt may be thrown to open the door by turning the knob, Q. To disconnect the hub from the knob, Q, from the inside the bit, L, is drawn out until the stud, J, is free from the casing, which is then turned one-half a revolution, and the stud allowed to drop into the shallow notch. The hub cannot then be moved, as the bit, L, is free from the knob.

Imitation Crystallized Tin Plates.

"To produce a fine imitation of crystallization," writes M. F. Carpenter, to the *Artisan*, of Chicago, "place a sheet of tin plate upon a smooth, level surface; sprinkle tartaric acid over the sheet, and with a clean cotton cloth wet in clean water rub long enough to cause the moisture from the cloth to adhere to the plate; immediately drop muriatic acid, which has been diluted with one-third water, over the plate, watching it carefully; as soon as the crystals have formed to a proper shade, wash off with clean water. The work can dry in the shade, without heating, and can be stained or varnished to please the taste. Avoid inhaling the fumes while using the acids. The above plate made up into ware and placed side by side with the genuine crystallized work will sell fifty per cent faster. At least I find that the case in my shop."

Astoria, Oregon, has 7,000 population in the fishing season, and 4,000 the rest of the year. She has a dozen canning establishments.

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THE ELECTRIC DIADEMS OF THE NEW BALLET "LA FARANDOLE."

The light is produced by an incandescent electric light of very small dimensions and of feeble resistance. The lamp is supplied by two chloride of silver piles which each coryphee carries with her in a scent box attached to her belt.

Fig. 1 shows the apparatus in very much reduced size. When the danseuses are dressed, they come, forty-eight at a time, into a large hall, in which extend long tables upon which lie the various apparatus inclosed in boxes, each bearing the name of a danseuse. Each of the latter then fastens around her waist the belt of silvered metal, containing the two piles inclosed in perfume boxes (Fig. 1), and places her diadem upon her head, while an assistant attaches to the middle of her tresses the conducting wires that connect the piles mounted in tension with the incandescent lamp.

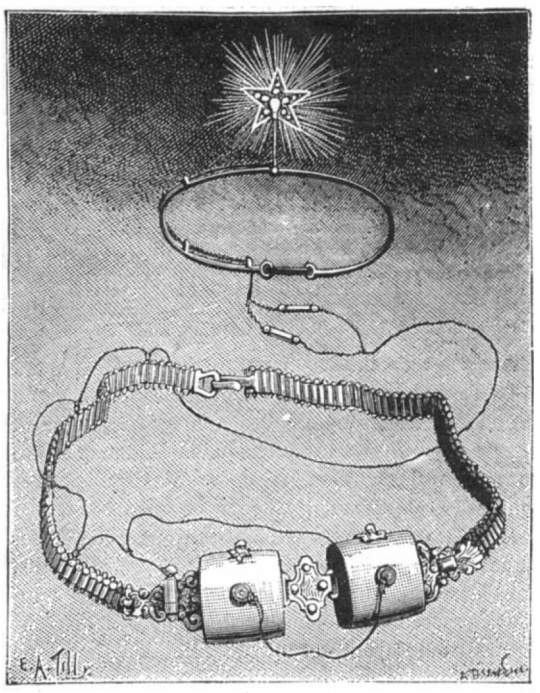


Fig. 1.—ELECTRIC DIADEM AND BELT USED IN THE BALLET OF THE FARANDOLE IN PARIS.

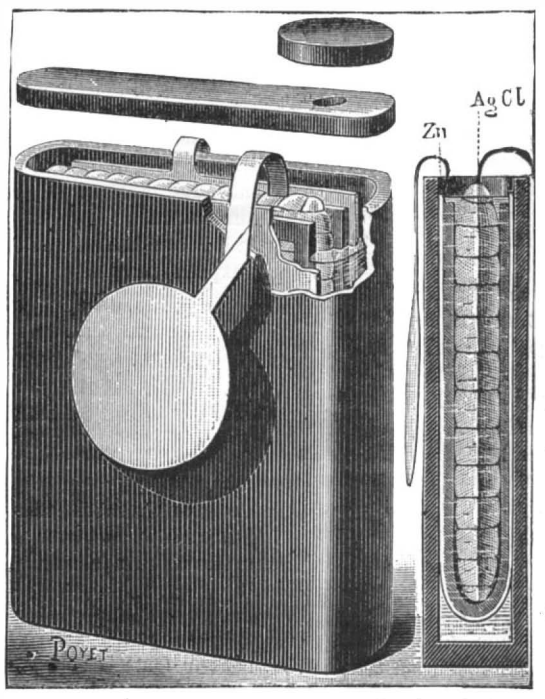


Fig. 2.—BATTERY USED WITH THE ELECTRIC DIADEM.

This done, the coryphees are assisted by a maid in adjusting around their waists a muslin scarf that nearly hides the apparatus. The incandescent lamp in the diadem is mounted in front of a metal star covered with green stones that imitate emeralds and form a reflector. To the belt there is fixed, at the side of the piles, a small commutator that permits the coryphee to close or open the circuit in order to light or extinguish her lamp at will. This commutator is very simple, and consists of a small cylinder of the size of a lead pencil, that is pushed into or drawn from a sheath in which it slides with slight friction.

The pile, which is the invention or Mr. Scrivanow, is shown in Fig. 2. It is held in a gutta-percha trough. The two electrodes consist of a strip of silver covered with chloride of the same metal and inclosed in a bag made of parchment paper. The bag is surrounded by a strip of zinc bent double, and from which it is insulated by a piece of perforated gutta-percha. The section of the pile represented to the right of the figure shows its arrangement. The zinc is figured at Zn, and the bag of chloride of silver at AgCl. The exciting liquid is an alkaline solution formed of very dilute potassa. The gutta-percha trough, with the electrodes passing out to the right and left, is hermetically closed by a plate of gutta-percha in which there is an aperture for the introduction and renewal of the liquid. This aperture is closed by a cork. In the engraving these pieces are shown separate in order to make the details and arrangement better understood.

Such is the ingenious system of electric lighting adopted by the management of the opera. The only objection that we can make to it is that it is wanting in luminous intensity; but, as each pile weighs but ninety grammes, it would be possible to use three instead of two, and thus obtain a much more remarkable effect. However this may be, there is reason for congratulating the organizers or the care that they have taken in this happy application. No so important experiment as this has hitherto been made upon a French stage in lighting a ballet electrically. The apparatus is light and portable, and may find an application in this winter's cotillons.—*La Nature.*

DUJOUR AND BIANCHI'S SINGLE AXLE WINDLASS.

Upon comparing our present mechanisms for hoisting with those that were formerly used, we find that the improvements that have been introduced into these apparatus are not numerous, despite the powerful devices that are brought into play in our time for the construction of mechanical pieces. For example, the windlasses in block and pulley 10 ton cranes have at least four axles and a dozen gearings (some of them 1·2 m. in diameter), while in the most remote times there was a differential wheel and axle that permitted of quite large loads being raised. It is true that we now have two speeds for the hoisting of loads, but this advantage is obtained at the expense of simplicity and convenience without avoiding the dangers that are run by the men who operate the apparatus.

The conditions that should be satisfied in the mechanism of a windlass may be formulated thus: (1) There should be as few mechanical parts as possible, and few points of contact with the frame; and (2) the arrangement should be such that stresses exceeding the maximum charge shall be avoided, and that the men who operate the apparatus be protected from accident.

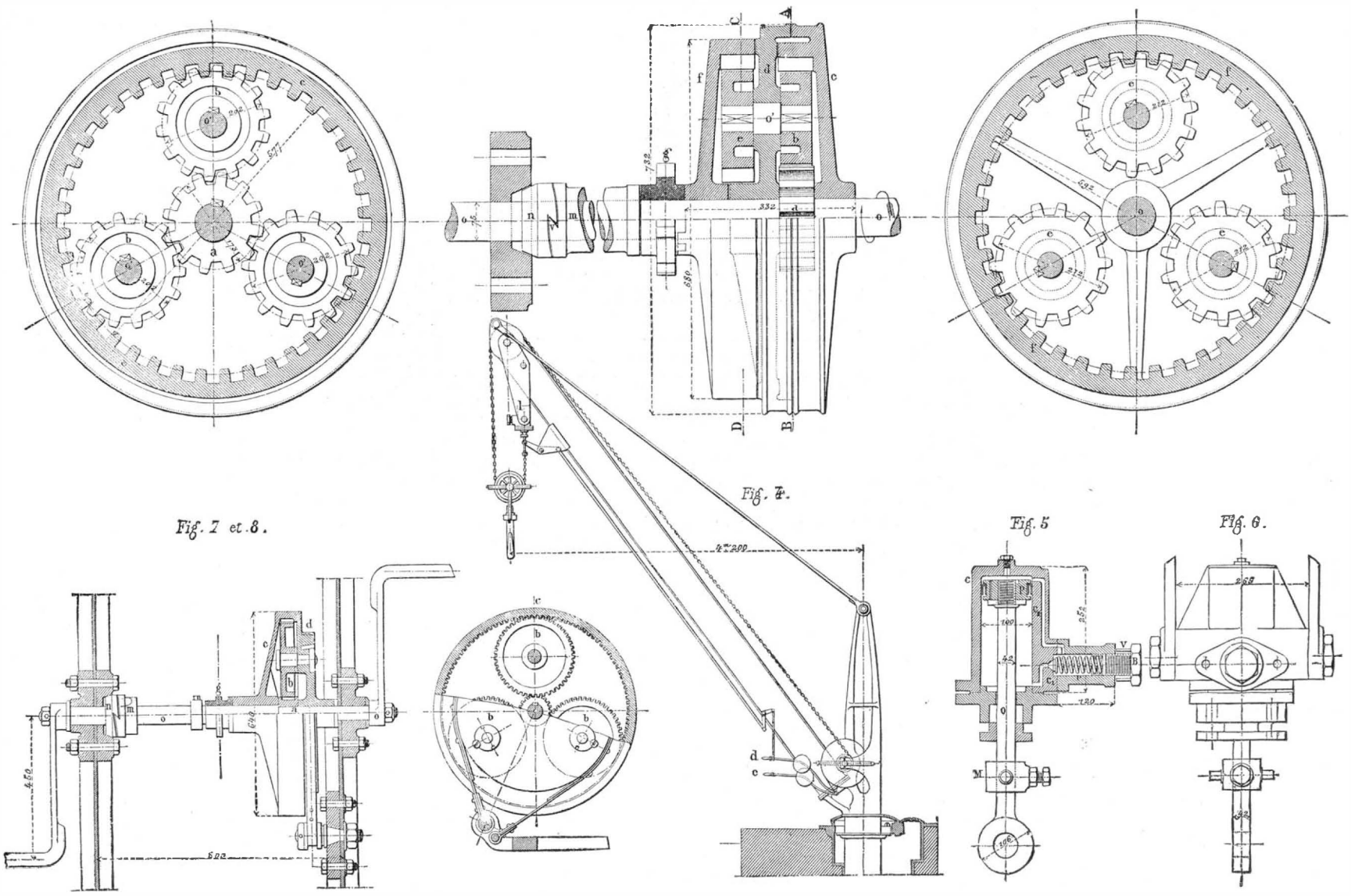
After an attentive study of this question, Messrs. Dujour and Bianchi have found a very ingenious solution of it by the invention of a single axle mechanism with automatic brake, with an automatic limiter of the load, and in which there is no reversal of the winch.

Figs. 1, 2, and 3 of the annexed engraving show the arrangement for a 10 ton crane.

The new mechanism consists essentially of an axle, O, upon which are keyed a pinion, *a*, and two winches at an angle of 180°. Then of three drums, *c*, *d*, *f*, and a ratchet, *g*, which revolve by slight friction around this same axis, and, finally, of a sleeve, *m*, that is capable of moving a friction disk, *n*, longitudinally along a hollow cone in one of the supports of the shaft.

When the rotation of O is positive, that is to say, when its effect is to lift the load when the winches are turned in the direction shown by the arrow, the tooth, *m* (which is beveled), carries along the sleeve, *n*, to the right and keeps it away from the support of the axle. On the contrary, when the axle revolves in the opposite direction the helicoidal surface, *v*, thrusts the disk, *n*, toward the left and puts it in contact with the grooving in the frame. The friction of the cones then acts in such a way as to stop the revolution of the axle. This arrangement may, moreover, be replaced by plane or penetrating surfaces, and even by a ratchet held by means of a click, in the running of the winches in a wrong direction.

Upon examining the engravings it will be seen that the drum, *d*, carries three axles, *o'*, upon each of which are keyed two wheels, *e* and *b*, one of which gears with the wheel, *f*, fixed to the ratchet, *g*, and the other with the pinion, *a*, and the wheel, *e*. The object of these three identical systems is to distribute the pressure over three gearings



DUJOUR AND BIANCHI'S SINGLE AXLE WINDLASS.

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whose dimensions are small, and upon three points of the circumference of the drums, *c*, *d*, and *f*, in such a way as to diminish the friction upon the axle, O. This apparatus is also provided with three friction bands that are actuated alternately by a single weight, or by two distinct ones, and capable of successively rendering immovable one or the other of the drums, *c* and *d*, during the raising of a load.

Herein consists the essential feature of this mechanism. In fact, if the drum, *c*, is rendered immovable, the annexed diagram shows that, upon revolving the pinion, A, a distance, *x*, the wheel, B, will make an entire revolution around the center, *b*, and this will carry along in its motion the gearing, E, whose point, *e*, will move in a direction contrary to *x* by a distance equal to

$$\frac{e\,b}{b\,a} \times x = \frac{d_2 - d_1}{2d_1} \times x.$$

Since the wheel, F, gears with the pinion, E, it will revolve this same distance around the axle, O, and carry along the ratchet, *g*, with which it is connected by a toothed gearing.

It suffices, then, to reduce at will the difference between the diameters of the two wheels, B and E, in order to increase the ratio of the pinion, A, to the ratchet, *g*. Upon making E=B, the wheel, A, would not revolve, that is to say, the ratio would be infinite. Finally, with E < B it would revolve in the same direction as the axle, O.

In designating the diameter of the circle traversed by the winches by D, and that of the ratchet, *g* by δ, the ratio of the chain's velocities to the winches is given by the following expression, when the drum, *c*, is immovable and *d* is free:

$$\frac{d}{D} \times \frac{d_2 - d_1}{2d_1} \times \frac{\delta}{d + d_1 + d_2}.$$

On another hand, on making the drum, *d*, immovable, it will be at once seen that the motion, *x*, of the pinion, *a*, will be transmitted to the wheel, *f*, whose revolution corresponds to

$$\frac{d_2}{d_1} \times x.$$

In this case the ratio of the chain's velocities is only

$$\frac{d}{D} \times \frac{d_2}{d_1} \times \frac{\delta}{d + d_1 + d_2}.$$

On comparing the two above expressions, we obtain the following ratio:

$$\frac{d_2 - d_1}{2d_2} = 0{\cdot}50 \left(1 - \frac{d_1}{d_2}\right).$$

Now, for a 10 ton crane (5 tons upon the chain) this ratio is:

$$0{\cdot}50\,(1 - \tfrac{1}{2}\tfrac{0}{2}) = 0{\cdot}0684.$$

Thus, in rendering the drum, *d*, immovable we give each chain a velocity of 1: 0·0684 = 14·6 times greater than on locking the brake of the gearing, *c*.

Moreover, in case of $e < b$, instead of $e > b$, the wheel, *f*, will revolve in the opposite direction, as we have seen above. Consequently, a mechanism arranged in this way would possess at the same time two velocities having alternating motions, and might be applied to planing machines as well as to parallel lathes.

In order to obtain great velocity and an opposite direction of rotation, we should act upon the disk, *d*, while small velocity and a direct motion would be obtained in keying the drum, *c*.

Figs. 5 and 6 of the accompanying engraving represent the apparatus devised by Messrs. Dujour and Bianchi for automatically limiting the maximum load to be suspended from the crane. It consists of a cylinder, C, bolted to the crane post, and provided with a piston, P, whose rod, O, is fixed to the extremity of the chain. This cylinder is filled with a liquid that is not much affected by changes of temperature (water mixed with alcohol or glycerine). When the piston moves upward the liquid in the upper part passes out through the apertures, *t*, by raising the rubber linings, *p*; but, in the down stroke, the water can return to the top of the piston only by following the channels, c_1 and c_2, and by moving the valve, *v*, which is held upon its seat by a spring, *r*.

The piston, P, then, does not descend as long as the rod, O, is supporting a pressure less than that of the regulating spring. The tension of the latter is varied, as need be, by means of a screw, B, whose entrance is limited by a ferrule, V. These parts may also be covered by a safety nut.

Upon examining Fig. 4, it will be seen that the down stroke of the piston and the mechanism of transmission (consisting of a sleeve, *m*, and a rod and two angle bars) act upon one of the two brake levers, corresponding to the drums, *c* and *d*, in order to render the windlass immovable. This arrangement is preferable to a throwing out of gear, since the danger of a fall of the load due to too sudden a stoppage of its descent may thus be avoided.

The "limiter" also satisfies one condition essential to security by automatically rendering the windlass immovable when the breakage of any part occurs.

After being pushed down by a load greater than that of the regulation, the piston, P, is put back in place by raising the lever of the brake with which its rod is connected. The effect of this maneuver is to disengage the windlass. It is evident that the rod of this piston must be put in communication with the brake of the drum, *d*, whose revolution corresponds to the greatest power of the crane.

In sum, this windlass possesses but one axle, and is of modest dimensions for all powers. It is provided with an automatic gearing which prevents the winches from turning back during the descent of the load; with a brake that is continuously actuated by a weight, and that stops the load automatically, either on lifting, when the winches are left free, or on lowering, if the lever of the brake happens to be freed; and, lastly, with an apparatus for throwing the axle of the winches into gear when the weight to be lifted is too great for the crane.

We must also add to the interesting peculiarities of this mechanism the two ratios of the winches' velocity, and their change, which latter is effected without stopping the motion of the windlass. In cranes of small power this double velocity may be dispensed with without inconvenience, and the mechanism simplified, while its advantages are at the same time preserved. For example, the ratchet, *g*, being directly in gear with the drum, *d*, we may suppress the gearings, *e* and *f*, and preserve only one brake for rendering the drum, *c*, immovable.

In this case the ratio of the speeds is given by the following expression:

$$\frac{d}{D} \times \tfrac{1}{2} \times \frac{\delta}{d + d_1}.$$

Figs. 7 and 8 represent a windlass in which the drum, *d*, is rendered immovable, while the ratchet, *g*, is fixed to the wheel, *c*. The ratio of the velocities we write thus:

$$\frac{d}{D} \times \frac{\delta}{2d_1 + d}.$$

The gearings employed in both systems present no danger for the men who operate them, since they are entirely inclosed in a drum belonging to the very parts of the windlass.

Moreover, their arrangement is applicable to all hoisting apparatus, and, in general, to the mechanism of lathes and machine tools in which are utilized one or several trains of gearings either for increasing the force and diminishing the velocity, or for having an alternating motion with change of running.—*Revue Industrielle.*

Beer Soured by Thunder.

It has long been a matter of common observation that beer, milk, and other substances liable to decomposition, undergo rapid and adverse fermentative changes during thundery weather, and "turned sour by thunder" is the generally accepted explanation of much beer going to the bad. It has been somewhat difficult to reconcile the modern theory of fermentation by germs with the well-recognized phenomena attending thunder storms, and the changes which then take place are more consistent with Liebig's cataclytic theory, who attributed fermentation to molecular instability—"the ferment propagating to surrounding molecular groups the overthrow of its own tottering combinations." According to a paper "On the Effect of Heat on the Atmospheric Dust," recently read by Mr. Aitken before the Royal Society of Edinburgh, the author showed that a disturbed electrical condition of the atmosphere greatly favored the deposition of dust; and he suggested that this might be the explanation of the common belief that beer and milk readily turn sour in thundery weather, the electrical conditions leading to the deposition of a greater number of bacteria in a given time. This explanation would apply to beer exposed to the air in open vessels, but scarcely to beer in casks, which is practically protected from the atmosphere; and we know that the beer in casks often turns sour within a few hours of a thunder-storm. It is possible that the peculiar electrical conditions of the atmosphere preceding and accompanying a thunder-storm may galvanize into full vitality the myriads of disease ferments which must, under the most favorable circumstances, be present in every cask of beer brewed under our existing system, or that the vibrations caused by the peals of thunder may move a number of these minute organisms, which until then were lying dormant and inactive. —*Brewers' Guardian.*

Tempered Cast Steel.

We translate from the *Deutsche Industrie Zeitung* the following in regard to the manufacture and properties of tempered steel, a new industry that has spread into Westphalia and the Rhine provinces from Belgium. This metal is able to compete with malleable cast iron on the one hand and with cast steel on the other, while for many purposes it is superior to either. It is made from old steel and scrap steel, which is cut in small pieces and smelted with coke in the cupola furnace, and, like ordinary cast iron, run into slightly dried sand moulds. The liquid metal is intermediate in temperature between cast iron and cast steel, and throws off many sparks. The castings are tempered by packing them in powdered red hematite ore in boxes made of refractory stone and heated in tempering furnaces. The last operation imparts to it an extraordinary degree of strength and tenacity that renders it superior to ordinary cast steel.

Its superiority to malleable cast iron is due to the nature of the material; although both are decarbureted by tempering to a certain depth, yet it will take place more rapidly and be more perfect in cast steel than in cast iron. The articles made from the former are much stronger than those from the latter, because the unaltered core in the one case is of steel and in the other of cast iron.

The greatest advantage possessed by tempered cast steel over both malleable cast iron and cast steel is its cheapness. The price of old steel and of scrap is comparatively low, and the consumption of coke for melting it in a cupola furnace is not much higher than for smelting cast iron, while the crude materials employed for steel castings as well as for malleable cast iron are much more expensive and the consumption of fuel is much higher, independently of the cost of crucibles and of cast iron tempering boxes. Tempered cast steel today costs about one-half as much as malleable cast iron.

It must, however, be admitted that this tempered steel is frequently not as free from pores as malleable cast iron, and this might be expected. Recently considerable progress has been made in overcoming this difficulty, and in most cases a few individual pores do not damage the castings.

The tempered cast steel finds extended use for the manufacture of wheels of mine cars in Westphalia and Belgium coal mines; also for ore, coke, and slag wagons.

Tempered steel also can be employed with advantage for all articles that can be cast more cheaply than wrought, and require great strength and the power of resisting jar and concussion as well as sudden changes of temperature. The pipes through which melted slag from blast furnaces flows, if made of tempered steel, can be thrown into cold water without injury.

The manufacture of tempered steel offers no special difficulty, and any foundry can make it with a small outlay for cupola and tempering furnaces.

Manufacture of Cannon.

The Secretary of State has received from Consul Potter, at Crefeld, Germany, a report on Krupp's steel ordnance works at Essen, from which the following extracts are taken:

The forging process requires vast arrangements on account of the immense weight of the pieces which are to be handled, one of which sometimes weighs more than 60 tons. The steam hammer now in use for this purpose weighs 50 tons and has a stroke of 10 feet. Another hammer is now being constructed of much greater efficiency, weighing about 150 tons, which will cost over 10,000,000 marks ($2,500,000).

Mountain guns are finished in two months after work on them is begun, while two years are required to manufacture a 16 inch gun of 35 calibers length. This apparently long time is made necessary by reason of the large surfaces that have to be worked over on a steel cannon of this description 55 feet long and weighing 121 tons. Mr. Krupp's is the largest gun foundry in the world, being much more extensive and complete than the Government establishment of England at Woolwich. It is able to complete each year from 3,000 to 4,000 field and mountain guns, 500 siege, fortress, naval, and coast guns, of light caliber, and 100 heavy naval and coast guns.

Mr. Krupp is now engaged in constructing, upon the same principle as the gun above mentioned, 40 centimeter (16 inch) guns, of 35 calibers length, weighing 121 tons, for the Italian Government. Ten guns of this latter description have been ordered, it is said, at a cost of 894,000 f. each, for the purpose of coast defense. Particulars regarding weight and measure of these guns are not yet made public, but it is ascertained that they will send a projectile weighing considerably more than a ton through any armor which a ship can carry and float in an ordinary sea. There are some interesting particulars regarding the power of these guns which I am not yet permitted to make public. It is also stated that the Chinese Government has ordered guns for coast defense and naval purposes of similar dimensions and power, which are in process of construction at this time by Mr. Krupp, who has already furnished that Government with 425 cannon of less weight, and since June last has been engaged on a contract for 450 more of his powerful steel guns.

We would add to this that after seven years of idleness the larger furnace of the South Boston Iron Works was lighted up on March 1, for the casting of a 12 inch rifle mortar for the United States Ordnance Department. This is to be the first of a lot of five heavy experimental guns authorized by the last Congress. The second will be a 10 inch breech loading rifle. The body is to be of cast iron, re-enforced by a wrapping of steel wire. The third is to be a 12 inch breech loading rifle, entirely of cast iron, and is to weigh 57 tons. The fourth is to be like the third, with the exception that it is to be lined from the breech with a short steel tube, to reach a little beyond the trunnions. The fifth is to be a 12 inch breech loading rifle. The body, of cast iron, is to be re-enforced by steel rings around the breech and to be lined the full length with a steel tube. It is expected that these heavy rifles will endure charges of 200 to 300 pounds of powder, with projectiles weighing 700 pounds, giving a velocity sufficient to penetrate 24 inches of iron. The works also have contracts with the United States Navy Department for 6 and 8 inch steel breech loading rifles for the new steel cruisers, and for the conversion of 10 inch smooth bore "Rodman" guns into 8 inch muzzle loading rifles, for the War Department.

Color Blindness.

The Pennsylvania Railroad Company still continues the examination of its employes for color blindness and other defects. This has been continued for a number of years, the men being examined in batches. The general manager of the company states that these examinations have resulted thus far in ascertaining that about four per cent of those examined have proved defective either in hearing, vision, or ability to distinguish colors. Nearly 500 men have been so unfortunate as not to pass the examination, and were suspended.

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Correspondence.

"Mortality among Fishes."

To the Editor of the Scientific American:

In your paper of February 23 you print an article with this title, in which you give a series of statements from Mr. Charles Hallock. His theory and his assertions are sufficiently correct, but taken as a whole they convey an impression which is not correct, that is, if he means to imply that ice is a chief cause of the mortality, and that is certainly the way it reads.

The causes of death among fishes are many and varied, and some of them are quite imperfectly understood. Cold, however, is not prominent among these causes, nor the failure of aeration in the water from the freezing of its surface. They can be frozen perfectly stiff and solid and transported to any distance, without their vitality being destroyed, and yet the experiment may fail of success if the degree of cold is extreme.

I placed a small gold fish in a saucer of water and set him out during a winter night. In the morning the contents of the saucer were one solid cake, which was placed in a tub of cold water until it had slowly thawed, and in the tub was the little gold fish swimming about as merrily as though freezing was the nicest fun in the world. A few days later, when the temperature was below zero, I put him out again. He froze up so absolutely that the crystalline lens had become white, as when a fish is put into strong alcohol. He was thawed out in the same manner as before, but showed no signs of life; the extreme cold had been fatal.

At the same time I had a large gold fish in a tub of water in my barn. The tub was frozen over for weeks, and so nearly solid that while a small space directly surrounding the fish remained liquid there was not sufficient fluid in it to allow of his floating in his ordinary position, but the ice had crowded him down, and he lay on his side. I could see through the ice his fins moving now and then, and eventually I cut the block around the sides, and poured in water so as to float it. The gold fish at once celebrated his release by cruising around all parts of the tub below the ice.

The fact is that, while the water is so cold that the surface is frozen, the amount of oxygen required by the fish is so small that they can live almost indefinitely, and it has never been my experience to find dead fish floating on the breaking up of the ice.

On the contrary, I have seen them in great numbers in ponds and lakes wherever the water has become heated, during a long and hot summer; and that ice, by covering the surface of the water, is not a chief cause of mortality is manifest from the fact that the most wholesale destruction of which we are ever cognizant takes place in the open waters of the ocean or its bays. About four years ago a most remarkable and doubtless an extremely valuable fish was brought to our knowledge in the explorations of the United States Fish Commission, on the borders of the Gulf Stream, about the 100 fathom line, south of Martha's Vineyard. It was of a new type altogether, both genus and species new; it was named *Lopholatilus chamæleonticeps*, the fishermen calling it *tile fish*. Being in size like cod fish, and taking the bait on the trawl lines freely, while its table qualities were pronounced excellent, it bade fair to become a new product of national importance, perhaps even to rival the cod in amount. During the first season it was caught in abundance, and great preparations were made for the catch of 1882. But in March and April vessels coming across and along the Gulf Stream reported passing enormous quantities of dead fish of great size, sailing through them for many hours in succession. It was soon ascertained that these were tile fish; and the matter was deemed of so much importance that the Commission dispatched a fishing smack, the Josie Reeves, under the command of Captain J. W. Collins, to explore thoroughly the localities where the tile fish had been previously found in such abundance. This exploration was made in September, 1882, and showed very conclusively that the destruction of the species in that locality had been absolute or very nearly so. Captain Collins says that his investigation "continued uninterruptedly for three days, and 50 miles along the edge of the ground . . . with not the slightest indication of the presence of the tile fish."

To what we can attribute such a complete and widely extended destruction is not apparent. A storm of very great violence had preceded the presence of the dead fish at the surface, and in the absence of any other assignable cause it is very natural to attribute to the storm the injury done. But this is mere conjecture; other storms of probably equal violence have come and gone, and produced no such effects, nor is it easy to see how the surface movements due to the action of the wind could destroy the fish at the depth of 100 fathoms. It has been suggested that the agitation produced such an amount of intermingling of the cold water below with the warmer currents above as to kill the fish. This is possible, but no more.

Volcanic eruptions often destroy fish in great numbers, but there was no reason to suspect any such action in the matter of the *Lopholatilus*.

IT has been decided to furnish the London police with whistles, instead of the antiquated rattle. An order for 7,000 has been given. The whistle is of an improved make, and is said to be unusually shrill.

Utilizing Old Files.

Worn-out files appear to be one of the few discarded articles in a machine shop for which no extensive use can be found. And yet files are made of the best of cast steel and are in handy form for many purposes. The principal difficulty in the way of their economic utilization is that it costs more to remove the tooth marks and their consequences than the value of the resultant steel. It is quite futile to attempt the reforging of an old file so long as the chisel marks are left in; the steel will be "rotten." And it is not usually enough to barely remove the chisel cuts from sight, for the effect of the chisel cuts and hammer blows extends below their apparent bottom. It is evident, however, that there is a core of clean, useful steel below this corrugated surface.

In a shop recently visited a very inexpensive process of removing the tooth marks of old files was noticed. A belt led from a small pulley on the axle of the grindstone to a horizontal shaft near the floor, and as far forward as the front of the grindstone. This shaft carried a bevel gear that engaged with another on an upright shaft at the side of the grindstone frame, on the top of which was a slotted disk carrying a stud that could be secured at any point in the slot, thus forming a crank of differing radius. To this stud was attached a pitman that gave a reciprocating motion to a slide that received a file held at point and tang, the slide or its box being kept against the face of the stone by a spring. Thus the file was passed back and forth against the face of the stone, not only gradually losing its tooth corrugations, but keeping the stone razed to an even face. No attention was necessary, but an occasional turning of the file from one side or edge to another, and its removal and replacement by another file.

These smooth file blanks were then useful for a variety of purposes—scrapers for finishing, cutters for boring bars, flat reamers, etc.

The Brouardel Gas Lamp.

Among the high power gas burners used in France, the Brouardel system is favorably spoken of. This comprises two distinct parts—a special burner in a completely closed lantern, and a lighting cock permitting of the ignition of the gas at the burner from the outside, the latter being applicable to any form of burner. The Brouardel burner consists of an Argand, with a circular slit, the body of the burner being prolonged downward below the bottom of the lantern by a cylindrical tube; so that the air supply is restricted to this central tube. Above the center of the flame is a circular dished plate, sustained by a rod, which has the effect of directing the up-rushing current of air sideways against the internal surface of the flame.

The light is described as being of good shape and perfectly steady, showing an economy of about 40 per cent in comparison with the ordinary batswing. The lighting arrangement consists of a lantern cock with a hollow plug, having sideway openings so disposed that when turned at a certain angle gas escapes into the plug, and is continued through a vertical pipe to the level of the burner. The lamplighter's torch is then applied, and the mixture flashes up through the tube, burning until a further turn of the cock sends gas into the burner, and at the same time cuts off the temporary lighting flash. The action is so timed that as soon as the burner is alight the temporary supply ceases. It is claimed for this arrangement that it permits of the use of closed public lanterns, while at the same time dispensing with the pilot light, which may be extinguished by the wind, or by work done to the mains, in which case there would be the risk of explosion upon the introduction of a light into the lantern in the ordinary way.

A Theory of Light, Radiant Heat, Electricity and Magnetism.

The author of this pamphlet, Mr. I. E. Craig, of Ohio, proposes a new theory to explain the phenomena of radiant forces in nature. Not content with the existing theory of propagation by wave motion through the ether, he seeks to demonstrate that all the various radiant forces are functions of gravity, in other words, that Newton's great law of mutual attraction or gravitation applies equally as well to the molecules of bodies; and, while not denying, in a certain restricted sense, the wave-like character of these excitements, he seeks to demonstrate that they pass from molecule to molecule by reason of a disturbance of the equilibrium of their attractions. In conformity with his theory of the non-existence of the ether, he says that the interplanetary spaces are not voids, but filled with gaseous matter at the measure of attenuation corresponding to the temperature and pressure at which it exists, and this furnishes the material basis for the transmission of light and heat across cosmical spaces.

Tin found in Canned Asparagus.

In Germany a singular case occurred where several persons were taken ill after partaking of asparagus put up in tin cans or boxes. Unger and Bodlaender investigated the subject, and found that in the box where the tin had been removed the liquid contained no dissolved tin. This agreed with the former investigation of Wachendorff. An analysis of the suspended particles in the juice did not detect any tin in suspension, but in the vegetable itself there was found from 0·0331 to 0·0404 per cent of tin. This would indicate that the tin had been dissolved by the juices, and had subsequently entered into combination with some constituent of the asparagus, forming a solid insoluble substance which remained within the vegetable.

An analysis of canned apricots and strawberries gave similar results. There was no tin in the sirups, but there was some in the fruit; in apricots from 0·0185 to 0·0245 per cent, and in strawberries 0·0175 per cent of tin.

They have also proved that this tin is in part absorbed during digestion, and that when canned fruits and vegetables are consumed for a long time the tin may prove injurious to the health.

Type Blocks from Line Drawings and Half Tone Subjects.

At a recent meeting of the Society of Arts, London, Mr. Bolas said that phototypography and photolithography were almost the same thing—by the latter the proof being pulled off a prepared surface direct, while by the other the surface of a piece of zinc or other metal was etched into relief. It was probable that for every one picture produced by either process at the period of his last series of lectures there were ten produced now.

The production of these blocks is very easy when the subject is a line one, but not by any means so when the picture is in half tone. It might, however, be said that the problem was now solved. The basis of most transfers for line subjects was now, the lecturer said, as it had been before, a surface covered with gelatine and albumen sensitized with bichromate of potassium. He wished to illustrate the improvement brought about by the introduction of the velvet roller.

A piece of paper sensitized in the way described was exposed under a negative, and was inked over in the old manner with a fatty ink—that is to say, the whole surface was covered with a thin film of ink. The whole was then placed in warm water, when the gelatine which had not been acted upon by light swelled up and became repellent of the greasy ink, which was easily removed, none remaining except such as was over those parts which had been acted upon by light, and which, consequently, did not swell. This image was used to transfer on to a lithographic stone for lithographic working direct, or on to a zinc plate to be etched with acid.

With the velvet roller the process was quite different. Instead of the whole surface of the bichromated film being covered with ink the roller was passed gently over it several times, when the ink took on the exposed parts representing the lines at the end, and a beautifully delicate transfer was the result. A copy of the American *Patent Journal* was handed round to show examples of this kind of work. At this stage the lecturer passed around a couple of prints to illustrate the influence which photography had had upon the art illustrations of popular journals. One was an engraving in a London illustrated paper of 1851, and showed the conventional outlines of the wooden frames; the other was from *Harper's Magazine*, and showed a half tone picture which was as like an idealized photograph as anything could be.

Glass had been used for blocks, being etched with hydrofluoric acid. It was said that there was less undercutting in the case of glass than of metals. The fact was that photolithography had for long failed to make that progress which it might—not because there was anything wanting in the process, but because lithographic machinery had not been worked with very great success. To Messrs. Sprague & Company was, in great measure, due the credit of having put photolithographic machinery on a commercial basis.

In any half tone process it was necessary to get an image in lines, dots, or stipple. A stipple could be got, as was well known, on the gelatine direct, simply by the reticulation of a bichromated gelatine surface. This could be used as a transfer. This process had been worked by Herr Pretsch, in 1860, and he (Mr. Bolas) thought that some of the results obtained by him then had scarcely been surpassed. It was marvelous how the reticulations would at times follow the outlines of trellis work and such like.

Mr. Bolas warned his audience that in judging the merits of various works shown on the walls of the room it was most necessary to take into consideration the amount of care spent in the printing. Thus, some of the roughest there might in reality exhibit the most merit, inasmuch as no great care had been bestowed on the printing.

The method of getting a transfer by the use of a network was mentioned, and it was remarked that Meisenbach had, among other things, claimed as a novelty the adoption of slight motion of this network during exposure.

In 1873 Mr. W. B. Woodbury patented a method of reducing his gelatine relief into stipple, which promised well.

The Ives process was then described and illustrated. A Woodbury relief was inked and was brought into contact with grained paper. By this means, where the image was high the pyramids forming the grain of the paper were depressed, and a large dot resulted. Where the image was low the tips of the pyramids were merely touched, and a very small dot was produced. The image thus got was used as a transfer or, better, as a means of getting a negative in stipple. If a transfer was taken direct, the small spots were liable to spread out to some extent and to give a blurred effect.

Zuccato's process was then explained. A block of type metal is planed in very fine grooves. The block is now inked, a piece of paper is placed behind it, and behind that is placed the Woodbury relief. Pressure flattened the ridges of the type metal to different degrees and produced lines of different widths. A beautifully defined transfer was thus obtained.

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PETROLEUM AT BAKU.

For years past it has been, not Yankee boasting, but a simple statement of fact, to say that America supplied the world with petroleum. The output from our "Oil Region" has been so enormous and so vastly greater than that of all other countries combined, that we have been able to rule the market completely.

While petroleum is well known to exist very widely, there are but two prominent localities on the Eastern Continent. One of these is on the Irawaddy, and from that well up through Assam; the other on the western shore of the Caspian, around Baku. Both of these have been long known, and the indications have been that their production might be rendered very great; but they remained comparatively undeveloped, the eastern region sending to market only about 50,000 barrels annually, while Baku turned out 500,000.

A great and most remarkable change, however, has taken place within the last few months, and it is worth our while to look at it and study as well as we may briefly the probable and possible results.

Baku has since the close of last summer suddenly sprung into a degree of vitality and a measure of prosperity and importance of which no one had previously any reason to dream, and all because its subterranean wealth is pouring forth its treasures in a most unwonted fashion. We in this country have been familiar with "spouting wells" of petroleum, but there such a thing had never been known. Something over five months ago several "rich strikes," as our people term them, began to attract attention, and new wells were bored in numbers, and yielded astonishingly. At length one of the augers entered a cavity which was really worthy of Oil Creek in its best estate. It was a "spouter," sure enough, and threw its oily jet high into the air with great violence. This was followed by another and another, some throwing their torrent of petroleum to the height of fifty feet or more. Of course, this fierce outpouring, as in all such cases, diminished within a few days, as the extreme tension from beneath was relieved, but the wells continued to yield at a rate new for the entire region. Additional wells were bored in great numbers, and the work is still going on and increasing, and the end is not yet by any manner of means.

The natural results of this have followed. Baku has grown like one of our own Oil Region towns, and being, unlike our own localities, situated directly on a great inland sea, a mercantile navy has begun even within this brief space to grow into existence. It is not to be supposed that men as astute as those ruling the great Russian nation fail to see the immense futures to which this may lead, and the Government is taking active and energetic measures to make the most of the new state of things. Means of transportation are provided rapidly to every part of the Caspian and its affluents, notably the Volga. A pipe line is already planned to run the petroleum across to the Black Sea, a stretch of about five hundred miles. Once there, of course it has access to all of eastern Europe, and in fact to the markets of the world.

The Government officers are prosecuting most industriously and untiringly their efforts to make the burning of crude petroleum a practical matter for the generation of steam. They have accomplished much, as noted in our paper of October 13, and they will very possibly work out the problem.

All this is not of so much consequence from what has already been done, as from the probable future to which it looks. No one can say that there is any reason, from the nature of the formation geologically, why the country about Baku should not pour out fully as great floods of oil as our own regions of northwestern Pennsylvania and its surroundings; why it should not add a cipher to its previous 500,000 barrels and double or treble it. If so, American petroleum will no longer have the free swing it has hitherto enjoyed.

But in relation to this, one very important element must not be overlooked. Russian petroleum is a very different article from the American. They both certainly belong to the same series of hydrocarbons, yielding the same class of products by fractional distillation; but they yield them in very different proportions. The value of our Pennsylvania petroleum is greatly enhanced from the fact that so large a proportion of kerosene can be obtained from it, the kerosene being that part of the product of distillation which comes from the retort after the gravity has reached 65° B., and from that until about 38°; and this in our oil is very near double, and sometimes fully so, that which can be obtained from Baku petroleum. Here we have a great advantage, and it must always remain; and inasmuch as such a great amount of petroleum is demanded solely for the purposes of illumination, this point is of prime importance. It is worth mentioning here, that we have a striking dissimilarity in our petroleums, that of California differing more in its proportions from Pennsylvania oil than does that of Baku.

One feature more is worth noting, but it is in a totally different line—it is the part which this outburst at Baku may possibly have on the political history of Europe. The English papers are already indicating alarm. That crowd of oil vessels on the Caspian could very easily and without warning transport Russian forces to the southeast waters of the Caspian, their progress toward the frontier of Afghanistan need not be known, and they might be within a few days' march of Herat before a suspicion of danger arose. All this may be of no moment, but it is certainly practicable; and who can tell when such a contingency may be turned to a certainty? At all events, it has been mentioned as a thing to be watched. Our engraving is from the London *Graphic*.

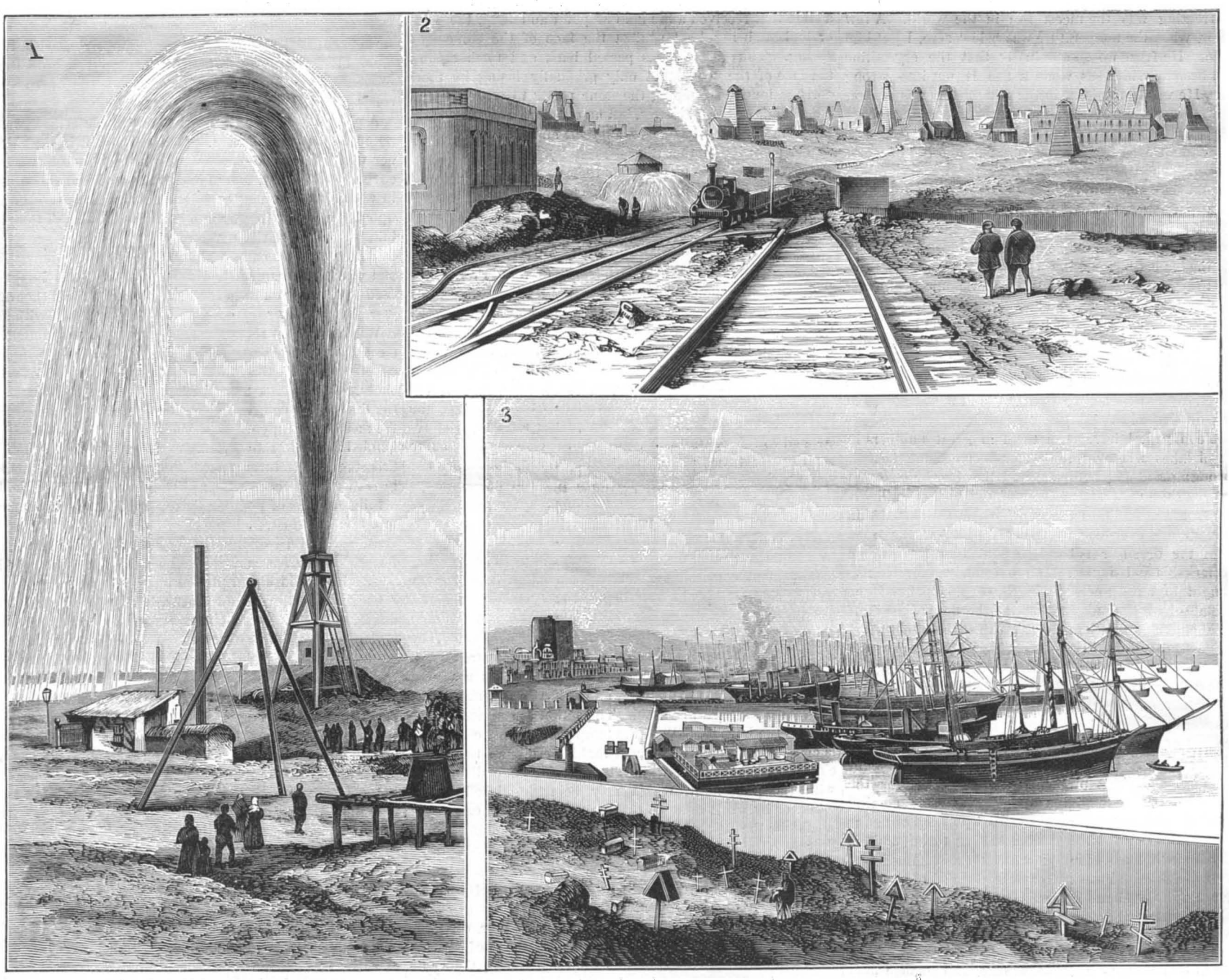
Port Jackson Light, Australia.

One of the finest examples of lighthouse construction the world possesses is that at the entrance to Port Jackson, Australia, called the Macquarie Light. It is a first order, sixteen-sided, dioptric, holophotal revolving white light, of the system of Fresnel, showing a flash of eight seconds in every minute, and having a range of twenty-five miles seaward. It was constructed by Messrs. Chance Bros. & Co., of Birmingham, under the supervision of Sir J. N. Douglass, Engineer to the Trinity Board.

The gas and oil burners for use during clear weather have, with flames of 1½ inches diameter, an intensity of about 200 candles instead of 80 candles with the same diameter, as with the old type of burner originally intended.

When these flames are at the focus, there is a consumption of about 40 cubic feet per hour of 16 candle gas, and of good paraffin about 1 pint per hour; and it is estimated that the mean intensity of the flashes from the apparatus is about 40,000 candles, or about five times the intensity of the flashes of the old Macquarie Light. With the full power of the electric light (used in conjunction with the gas in hazy weather) at the focus, the mean intensity of the flashes in the direction of the sea horizon is not less than five or six million candles.

By a simple arrangement the change from gas light to electric light at the focus, or the reverse, can be effected in ten seconds, and the flames of the oil lamp can be substituted for the gas or electric light in nearly the same space of time. The Macquarie Light is intended only to illumine half the horizon. It is, therefore, possible to make use of the landward rays by means of a dioptric mirror. This is probably the first instance of the use of a dioptric mirror for an electric light. Arrangements are made to burn either gas or paraffin oil, or to exhibit the electric light at full power or half power. When the electric light is in use there is always a second lamp in readiness for action.



1. A Petroleum Fountain During the First Five Days. 2. The Petroleum Wells. 3. The Harbor of Baku.

THE PETROLEUM WELLS OF BAKU, ON THE CASPIAN SEA.

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Teaching Animals to Converse.

H. Stuart Wortley writes as follows to *Nature:* A dog of mine knows instantly whether he may go out with my housekeeper or not, according to whether she wears her hat or her bonnet. In the first instance he knows she is going where he may go, and he is on his feet barking with joy as soon as she appears. If she has the bonnet on, he knows it to be church, or a visit to friends in the country, where he cannot go, and, like the "eldest oyster" (I quote from memory), he "winks his eye, and shakes his hoary head." If drawings of hat and bonnet were made, he would know them at once.

Some years since I had a remarkably clever Skye terrier, whose wisdom was at the time shown in a letter to the *Times*. This dog I taught as follows: When I went out it was quite sufficient to say "Yes" or "No" in an ordinary tone; but wanting to take him beyond that, I taught him very quickly to know the two words when printed on cards, YES or NO, and after a few weeks' teaching he never mistook them. I have no time now for much teaching; if I had, I am sure it could be done with the dog I now have.

The intelligence of cats is greatly underrated. My wife's favorite cat follows her everywhere, and comes when called wherever she may be. Cats, too, are very grateful for kindness. When I went into the Malakhoff, I found a cat on whose paw a bayonet had fallen and pinned it to the ground. I released it and took it home, and it always followed me all over camp till the end of the war. And this cat did as follows: I took her to a doctor of the nearest regiment for two mornings to have her foot dressed. The third morning I was away on duty before daylight, and the cat went herself to the doctor's tent, scratched the canvas to be let in, and then held up her paw to be doctored. The intelligence that can be developed in almost any animal depends in most cases on our treatment of it.

The Duty on Works of Art.

The tariff act of 1883 advanced the rate of duty on paintings in oil or water colors, and on statuary, to 30 per cent *ad valorem*, instead of 10 per cent, as it had theretofore been. The imports under this head for the fiscal year 1882 were $2,550,000, and the late tariff commission recommended a duty of 40 per cent. Representative Perry Belmont, of New York, has now introduced a bill wholly exempting from duty works of art, ancient or modern, the term to be construed as including all paintings, drawings, and photographs, and statues of marble or other stone.

The argument favoring a high duty on this class of imports can have no other foundation than that such goods are brought here only by the rich, as luxuries, and for that reason should pay as high a revenue to the Government as possible. But there is another side to the question. Works of art are educators of the people, and, in public galleries or private collections, they exert a far-reaching influence in elevating the taste and exalting the ideals which touch the mainsprings of human life.

No question of protection or of free trade can enter into any consideration of placing a duty on such products, for the American artists are strenuous supporters of the Belmont bill, and the most of them, also, feel it a necessity of their education that their opportunities for studying European work, modern as well as ancient, shall be as free and unrestricted as possible. This, therefore, seems to be a case where we should adopt Goethe's saying, "Encourage the beautiful; the useful will take care of itself," to the extent, at least, of allowing artists' work to be imported duty free.

Sagacity of the Horse.

On my farm, one Sunday, the house was left in charge of one man, who sat on the porch reading. A mare, with her young foal, was grazing in the orchard near by. At length he saw the mare coming from a distant part of the orchard at full speed, making a loud outcry—a sort of unnatural whinny, but, as he says, more like a scream of distress than the natural voice of the horse. She came as near to the man as the fence would allow, and then turned back for a few rods, and then returned, all the while keeping up the unnatural outcry. So soon as he started to follow her she ran back in the direction of a morass or miry place which had been left unguarded, and only stopped on its very brink. The man hastened to the spot with all speed, and found the colt mired in the soft mud and water. It was already dead. —*J. D. Caton, in American Naturalist.*

Beauties of the Cable System.

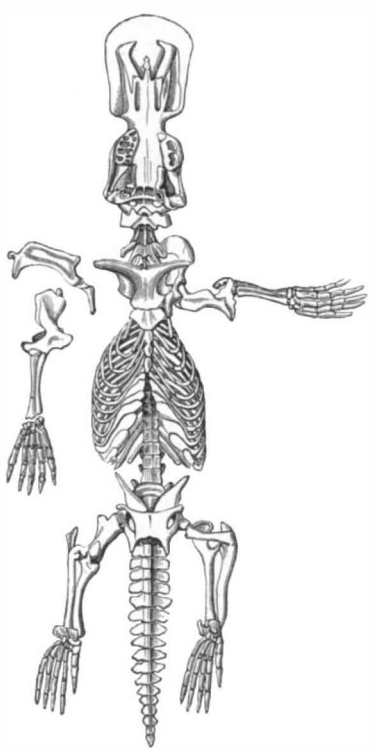
The Chicago street cable cars came to a sudden stop the other day by the breakage of a cog on one of the main driving wheels. Horses had to be substituted on the entire line for a day or two.

THE ORNITHORHYNCHUS.

(*Ornithorhynchus paradoxus.*)

BY L. P. GRATACAP.

This interesting animal has proved both a perplexity and a delight to naturalists. Its little body is so curiously constructed as to remind the student of structural affinities in animals of three types of life—the mammals, birds, and reptiles. It undoubtedly belongs to the former, but it enters that class at its lowest point, and brings along with it features and reminiscences of more degraded forms than itself. It is a welcome gift to the evolutionist, and he has not been loth to emphasize every indication it gives of its intermediate and connective character. In spite of these suggestive



SKELETON OF THE ORNITHORHYNCHUS.

resemblances the ornithorhynchus is essentially *mammalian*, though holding the humblest position in this group. With its singular ally, the *Echidna*—the porcupine anteater—it forms the division of *Ornithodelphia*, and is especially characterized by a strange provision in its economy, by which the fæces and young are extruded through the same passage, as the spacious cloaca is common to the rectum, genital, and urinary organs. Hence, the technical appellation of *Monotremata*.

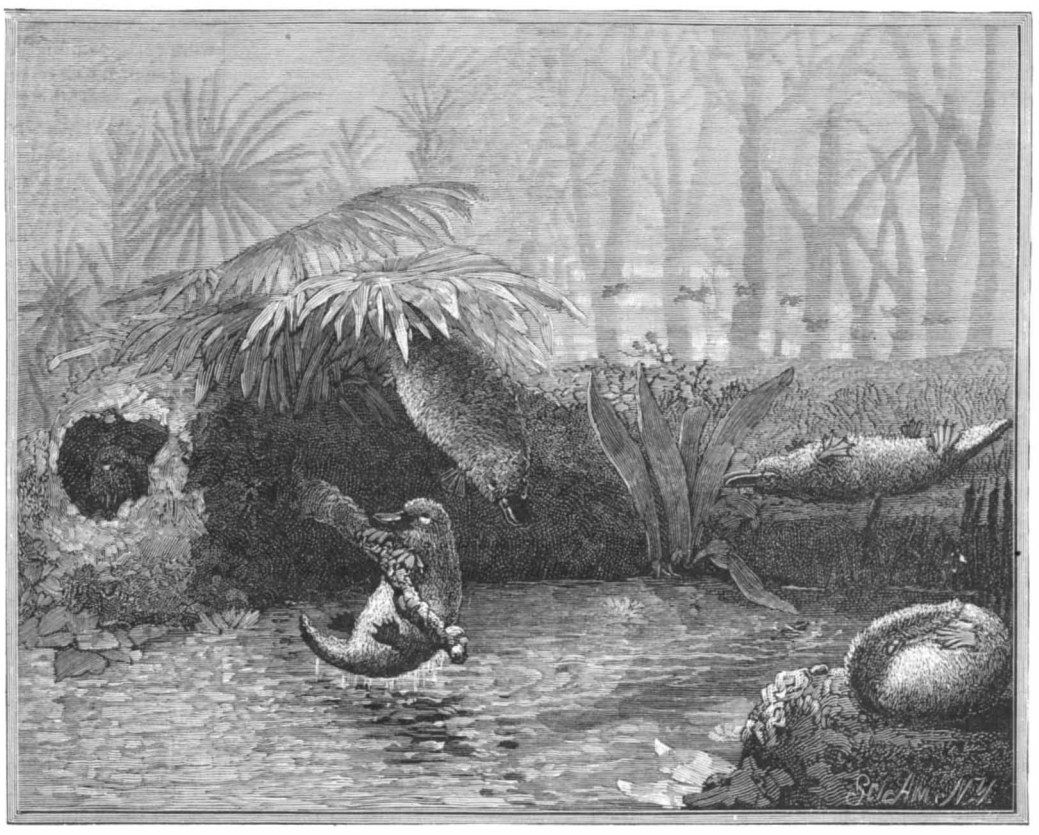
The features which ally it to the amphibia or reptiles are chiefly found in the skeleton, and are the following, among others less obvious: A projection of the second neck vertebra, called the "odontoid process," remains for a long time disconnected from the vertebra itself, upon which it is normally soldered by a long growth between the surfaces. Some of the cervical ribs in a similar way remain free.

The coracoid bone, which in man is a process only of the scapular or shoulder blade, but in birds is a separate bone, as also in reptiles, and which is a large bone in this animal, articulates with the sternum or breast bone directly. This is a positive amphibian and avian feature. There is an ossification in front of this bone, called the *epicoracoid*, which resembles a similar portion of the reptilian frame. In these mammals alone there is a T-shaped bone supporting the shoulder blades or clavicles. The *acetabulum*, or cavity, into which the head of the femur is thrust as in a socket, remains unossified at its center, thus resembling birds and crocodiles. Other points in its anatomy and physiology strongly suggest its indeterminate and dependent character, but its nature and functions place it beyond appeal among the mammals as a class.

The ornithorhynchus, by its grotesque union of the externals of a duck, beaver, and mole, its restricted range geographically, and the singular and unwarranted tales told of its habits by natives of Australia, has always formed a natural curiosity, and been regarded with mingled feelings of amusement and astonishment. The first skin of this animal sent to England presented such anomalous features that it was regarded as the playful hoax of some ingenious collector. A duck's bill and a mole's body presented a zoological complication which at first could not be considered seriously.

The ornithorhynchus is about the size of its congener the echidna, having an average length of 50 cm. (1 ft. 7·6 in.), 12 of which measure the normal length of its tail. The males are larger than the females. The flattened body is not dissimilar in some aspects to that of the beaver or fish otter. The bones are short, each foot or paw is provided with five claws, which are webbed, and this integument on the front feet is developed to such a degree as to extend beyond the extremities of the claws; it folds or draws back at the will of the creature, permitting it to use its serviceable talons or nails for digging and excavating. The short hinder feet are turned backward, and are usually placed in that position, and the nails, which are longer and sharper than those of the front feet, are similarly bent backward. In the males, above the toes of the hinder feet, there is a spur which admits of considerable movement. The tail is flat, broad, abruptly terminated, and in the younger specimens provided plentifully with hair, which disappears with age.

The head is quite flat, and forms the most distinguishing feature in its appearance. It is small and furnished with a duck bill, at the base of which a leathery apron-like expansion is developed, which acts as a shield, protecting the eyes when the animal burrows in the ground, and guarding the fine fur behind it from the slime of the muddy bottoms where it searches for its food. The jaws are prolonged forward and carry no teeth; the margins of the duck-like bill are sheathed with horn and crossed with horny plates. The tongue is fleshy, armed with horny carunculations and terminated at its base by a ball-like swelling which closes the throat. The eyes are small, and the barely noticeable ears, sunk in the head near the outer angle of the eyes, are closed at will. The fur on the upper surface of the animal is dark brown, sometimes reddish; it is composed of one set of long hairs which are somewhat stiff, and of another shorter growth of fine gray hairs, similar to the wooly coating of the seal. The fur on the breast and neck is silken and yellowish. The bill is black, spotted with light points, and is red at its extremity. The fur of the tail varies in color, which has given rise to suspicions of different species, and in the younger individuals it is coated with fine and silver white hairs, an almost unmistakable indication of immaturity.



THE ORNITHORHYNCHUS.

The ornithorhynchus inhabits the still pools of streams where water plants abound, and over whose serene expanse trees bend their shadowing branches. Here it pursues its amphibious existence, hunting the insects which haunt the water, grubbing around the esculent roots of plants, building its home, and eluding pursuit when the natives, who regard it as a delectable morsel, watch patiently for its appearance, spear in hand, upon the banks of the pond. The traveler who is fortunate enough to surprise these animals when actively engaged in their pursuit of food, must remain preternaturally still, if he wishes to enjoy the novel spectacle. If the water is clear and the light favorable, he will see them moving rapidly beneath the water, avidly inspecting the soft banks for beetles; they will rise to the surface every two or more minutes, again disappear to emerge later at a distant point. The slightest movement or noise is instantly detected, and the shy, strange animal is put to flight, and the chagrined spectator must endure a prolonged watch before it reappears.

The nest of the ornithorhynchus is located under ground, and is placed at the end of a long, underground, devious passageway, which may be, in exceptional cases, 45 feet long, although more usually 10 feet. This avenue of approach is strewn with dry leaves, as is also the kettle-like hole in which it ends. These homes of the ornithorhynchus are entered by two passages, one above and the other below the surface of the water. Almost invariably the nest is

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placed beyond danger of the infiltrating waters of the highest tide.

At rest the animal assumes various positions; the two most familiar are shown in the accompanying illustration. It rolls itself up in a ball with its fore feet tucked under its bill, its hind feet pressed tightly over it, and its tail drawn down over all, or else it lies on its back with its four feet stretched upward in languid delight.

The natives aver that the female lays eggs, and that the male inflicts poisonous wounds with its spur, both of which stories, formerly received with credulity, have been abundantly disproved.

The Trade in Modern Antiquities.

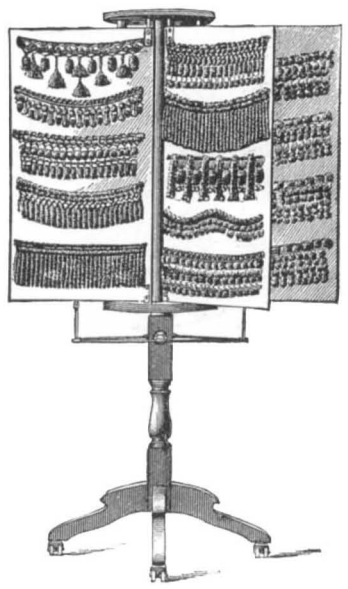
One of the chief delights of Continental travel, as every person of experience will admit, is the unlimited opportunities it affords for buying antiquities. The statuary, the coins, and the pictures that may be purchased in Italy are a score of never failing interest to English travelers and of never failing profit to Italian dealers. Andalusia, again, is a huge curiosity shop. Being once upon a time in Seville, we came across a retired British grocer or tailor, or something of that kind, who had just purchased a Madonna and Child—unhappily, unsigned—which he had picked up for a few pounds in a dingy back street. He was going to send it to the Exhibition of Old Masters, and, if he ever did so, he probably found that it was worth only a pound or thirty shillings at the outside. It is the same, indeed, throughout Spain. The altar cloths, the broken fans, the inlaid tables and cabinets, as resplendent as anything in the convent of the Cartufle at Granada, the wonderful chairs, and the still more extraordinary scraps of ancient lace, upon which all who have ever traveled in Spain have spent much money—these abound from Malaga to Irun, and naturally one is inclined to speculate a little on the odd circumstance that the supply is more abundant than ever, although the demand is fairly brisk. Tangiers is, we should say, a hotbed of modern antiquities, and even Mr. Chamberlain bought some of them when he was over there a year or so ago. He ought to have known something about this class of goods, being a Birmingham man, but the childlike faith of the President of the Board of Trade in all things ancient is notorious. America, oddly enough, has taken to this business of manufacturing the antique Dutch cabinets that, with bronze panels, dingy and marked with the cracks of fictitious centuries, are turned out every day from Chicago furniture stores, and for some purposes they are quite as useful as if they had indeed belonged to some departed burgher in the dead cities of the Zuyder-Zee. New York experts in this sort of forgery make a specialty of Queen Anne chairs and tables, and the imitation is so perfect as to deceive all but those who have studied such things minutely in Europe. The explorer of furniture stores may come upon magnificent specimens of English Gothic chamber pieces or ancient-looking Chippendale and Sheraton chairs,* which might have belonged to Queen Elizabeth but for the fact that they did not. It must be puzzling at first to discover in New York shops stamped leather chairs of the time of Louis Treize, plentifully ornamented with brass nails, whose heads are fully an inch in diameter, and the citizens of that enterprising city are invited to become the happy possessors of as many of these treasures as they like on ridiculously low terms. If, however, the explorer is inquisitive, and the furniture venders are in a tolerably candid mood, the visitor may be conducted into some back yard where these gems of high art are produced. A Queen Anne's chair just made can, for instance, be supplied with worm holes by the simple process of tilting it bottom side up and firing a charge of pigeon shot into the bottom and front of the seat. Old armor, too, is a good line in this business, the drawings required for the purpose being made from the collection in the Grand Opera House, in Paris. It is said that Birmingham knows something about this branch of the trade, and that helmets, shields, casques, breast plates, and complete suits of mail are regularly manufactured for the gratification of credulous oil speculators and retired pill manufacturers. If a man starts a lot of ancestors he likes to have dummies of them in his hall rigged in their mediæval ironmongery. If Birmingham did not gratify him, Germany would. It is astonishing how many tons of antiquities are annually sold along the Rhine, and it is even asserted that in Castle Colburg, where Martin Luther threw his inkstand at the devil—and unhappily, missed him—the original splash was cut up and sold long ago; but that, as the timber is massive, the place is carefully reinked every night for the purposes of sale next day. We cannot say how much truth or falsehood there may be in this particular story. There might have been some excitement in seeing the original transaction if both the distinguished parties to it were present. There can be none in gazing on a patch of ink. The trade in modern antiquities, however, is a curious reality, as real as the sale of old clothes or tombstones. It is a fact calculated to weaken one's faith in life.—*The British Trade Journal.*

THE *American Journal of Railway Appliances* says there is money for some one who will devise a practical skid for freight cars; one that is part and parcel of the car is necessary, so that it may not be detached except for repairs, and there should be one to each door. It is not possible to convert a portion of each door to this purpose, the editor adds.

* For examples of both the Chippendale and Sheraton styles of furniture see SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 389 and 391.

IMPROVED ROTATING SAMPLE STAND.

The engraving represents an invention recently patented by Mr. C. A. Schmidt, of 449 and 451 West Fourteenth Street, New York city, which provides a simple and convenient means for effectively displaying samples of fringes and other goods. The rotary sample stand is constructed with an upright standard, in the upper end of which is a socket, in which revolves a pivot attached to the under side of the upper disk. Near the base of the standard is a second disk, rigidly attached to the upper one, and between the two are hinged skeleton wings, upon which are arranged samples of the goods to be shown. As it revolves, the



outer edges of the wings come in contact with a spring attached to a stationary support, each wing being detained as long as the salesman may desire in order that the samples may be inspected.

By the use of this stand the salesman is permitted to display goods which have been previously arranged harmoniously and in order, thus presenting the most pleasing appearance. Any wing can be selected and brought forward instantly, the construction enabling them to be turned equally well either backward or forward. The time of the salesman and customer is saved, as a large and varied stock can be quickly shown. Since goods are not removed from the shelves until sold, the damaging effects resulting from repeated handling and lying about on the counter are obviated.

IMPROVED PAIL.

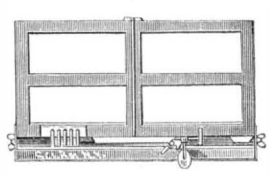
To the upper edge of the body of the pail is seamed the outer edge of an inwardly projecting rim, in the under side of which, near its inner edge, is formed an annular recess to receive an iron ring. The edge of the rim is spun down into a rabbet in the ring, so as to leave the mouth of the ves-

sel neat and smooth. With this construction the annular top of the vessel is strengthened so that it will not be liable to be bent by an accidental blow or by pressure. The cover of the pail is made of such a size that its edge will overlap the inner edge of the rim. An annular plate of rubber or other suitable material, held to the under side of the cover by a flange, serves as a packing between the cover and rim. To the center of the cover is secured the middle part of a spring rod, A, which is made of such a length that its ends will extend a little beyond the ears to which the bail is hinged. In the opposite side edges of the ears are formed recesses to receive the ends of the rods. The cover is thus held securely in place by the elasticity of the rod, and the escape of unpleasant odors is prevented.

This invention has been patented by Mr. Charles H. Paulus, of Irvington, N. J.

IMPROVED MUSIC LEAF TURNER.

Glued to the bottom of the rack is a narrow wooden lath which raises the book so that the pages in turning will



clear the strip formed on organs and pianos, and which prevents the trigger from striking the piano. In a groove in the center piece of the rack are placed wire arms, secured in such a way as to cause their elasticity to incline to the left when they are bent over to the right. On the ends of the wires are metal clamps which grasp the sheets of music. On grasping a page the wire is laid over to the right, and passed down a slot in an upright at the end of a plate from which its escape is prevented by a trigger. Each wire with its page is similarly treated. The wire arms are of unequal lengths.

Upon the trigger being moved downward, it allows the escape of the upper arm, which then turns the sheet attached to it. The surface of the trigger can be increased, so that the performer, by blowing upon it, can cause it to descend, thereby releasing the upper wire with its page. He is thus enabled to turn the pages of the music before him successively without removing his fingers from the keyboard. That end of the plate upon which the upright is secured can be raised or lowered in order to adjust the clamps to any required height to reach the pages of thick books without bending the wire arms.

Further information concerning this convenient device may be obtained from the manufacturers, Messrs. Wittman and Wimmer, of St. Mary's, Pa.

Rainbows.

Professor Tyndall lately delivered a lecture on rainbows before a crowded audience at the Royal Institution of Great Britain. The lecturer commenced by saying that the earliest historical record of the rainbow was that known to all present—"I do set my bow in the cloud, and it shall be for a token of a covenant between me and the earth." The sublime conception of the theologian exceeded that desire for exact knowledge which was characteristic of modern science. Whatever the ultimate cause of a rainbow might have been, the proximate cause was physical, and the aim of science was to refer a rainbow to its physical principles. After referring to the labors of Kepler and Willebrord Snell in investigating the phenomenon of the rainbow, Professor Tyndall said the explanation of the rainbow was due to Descartes. Descartes looked at the drops of rain, he pictured one a liquid sphere falling in the air, he pictured the rays of the sun falling upon a liquid sphere, he saw that certain portions of the light would be refracted, would be driven to the other side of the drop, back again, and would be again refracted on their emergence from the drop. He took a pen in his hand and calculated the entire course of the rays through the drop and their direction after their emergence from the drop. He found that the vast body of the rays after quitting the drop diverged at one particular angle; they came out as a parallel sheaf. There was a certain form of emotion called intellectual pleasure. It might be caused by poetry, literature, nature, or art, but he (Professor Tyndall) doubted whether there was a pleasure of the intellect more pure and concentrated than that of a scientific man, who, looking at a difficulty that had challenged the human mind for ages, saw that difficulty melt before his eyes and recrystallize as an illustration of a law of nature. Such pleasure, he thought, must have been that of Descartes, when he succeeded in uncovering the laws which ruled the appearance of the most brilliant meteor in nature. The lecturer referred to the experiments and conclusions of Descartes, Newton, Young, Miller, and Airy, and by means of diagrams explained the manner in which the rays of light were refracted in the rain drop. He also, by means of a shower of the fine spray of filtered water thrown by a minutely punctured jet suspended from the ceiling, caused a rainbow to appear in the room. The lecturer also described the appearance and cause of a very rare phenomenon known as the white rainbow, which was observed by him on Christmas day, and concluded his experiments by mixing the spray of some high flashing paraffin with that of some water, which, when illuminated with a strong ray of light, exhibited to the spectator two bows, the ordinary water bow surrounding the more luminous and more concentrated bow due to the paraffin oil.

The Dust Cloud from Krakatoa.

With reference to the Krakatoa eruption, Prof. Alph. Milne-Edwards read at the Paris Academy of Sciences, on January 28, a letter from a correspondent in Réunion, in which it is stated that the intensity of the sky-tints was always greatest where the showers of volcanic ashes had been observed. Thus the path of the volcanic cloud can be traced step by step, and its trajectory found to be that of an ordinary cyclone. M. Wolf showed how a study of the curves registered by the barometer establishes two atmospheric waves starting at the same time from Krakatoa, one toward the east and the other toward the west; the former to reach us had to traverse 11,500 kilometers, and the latter 13,500. M. Wolf showed that the rate of progress was that of sound, and on the basis of this and the distances, he found the eruption to have taken place on August 27, at 11 h. 43 m. A. M.

To Protect the Alligators.

The trunk, satchel, and pocket book manufacturers of New York city and Newark, N. J., have resolved that they will hereafter refuse to buy any skins that will not measure five feet in length. They have published notice to this effect to prevent the indiscriminate slaughter of small alligators by the hunters before the skins are large enough to become of much value. We do not suppose, however, that this resolution will have any effect in limiting the amount of imitation alligator leather made, or determining to what age the sheep shall live whose pelts supply so much of it.

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William Atwood.

William Atwood, Superintendent of the Portland Kerosene Oil Works and President of the Atwood Lead Works, both of Portland, Me., died on February 17 at his residence, near Portland, of heart disease. Mr. Atwood was widely known in connection with his inventions and devices for the more economical manufacture of coal-tar products, in which he had been engaged for nearly thirty years; formerly in company with his brother, the late Luther Atwood, a notice of whose death appeared in the SCIENTIFIC AMERICAN in the winter of 1868. But Mr. William Atwood was also an analytical chemist of remarkable skill, whose services were often called in use in cases of litigation, and always with entire certainty as to his accuracy and his perfect integrity. He was an omnivorous reader in general science, experimented largely with the spectroscope and microscope, and during many years never missed reading thoroughly every issue of the SCIENTIFIC AMERICAN, to which he has often been heard to attribute his thorough acquaintance with the progress of modern science. In 1873 Mr. Atwood was elected to the Maine Legislature, in which he served his term faithfully, retiring from politics and public life at its close, and returning to his scientific studies with renewed zest. In 1878 he was put in charge of the Queens County Oil Works, at Hunter's Point, L. I., where he remained until June, 1882, when he was recalled to his old position in Portland, where he continued until his death.

One of the most reticent and retiring of men, Mr. Atwood seldom gave one the opportunity to gauge his mental capacity or his acquirements; yet as to both he was remarkable. A clear-headed thinker and cogent reasoner, his integrity and splendid moral purpose entered into everything he did, so that it was as impossible for him to give a false or erroneous judgment as it was for him to commit intentionally a wrong act. Men, many years his senior, respected and admired in him the expression of a type of manhood so broad, and a knowledge and understanding so ripe, that age could not possibly improve either. A man who was never known to commit an injustice or unkindness, or even to speak unkindly of another, he was remarkable for a tenderness of nature and a beautiful geniality and generosity of spirit very rarely found in man or woman. A Royal Arch Mason and Knight Templar, he was buried with Masonic honors on February 20, the entire force of the works in his charge accompanying his remains through a blinding storm to the grave, while a delegation traveled from New York to Portland, that his friends here and the Queens County Oil Works should not be unrepresented at his funeral. Mr. Atwood's loss is a grave one to science and practical art, and must ever be a source of regret to those who knew him and honored him for his simple, manly nature, his earnestness, and his unswerving devotion to principle.

Milk Caseine for Sizing Paper.

Before the introduction of machinery for making paper, when each individual sheet was dipped by hand, animal size was almost exclusively employed. It was made from bones or gristle. When paper came to be made by machinery, a resin and alumina soap was substituted. This was a decided advantage for the manufacture on a large scale, but it often happens that paper sized in this way does not resist the penetration of ink very well, and a recognition of this fact has led, in recent times, to an increased inquiry for animal size on the better quality of paper. This paper is almost exclusively air dried, which takes time.

Muth, of Carlsruhe, has devised a method of making a machine paper of equally good quality and avoiding these disadvantages.

Albuminoid substances possess the greatest resemblance to animal glue, hence the supposition that they could be substituted for it. Egg and blood albumen are too expensive for use on a large scale, but the caseine of milk can be had in dairies in large quantities. It is but slightly soluble in pure water, but if the water is made slightly alkaline it dissolves, forming a milky liquid, and in this form can be used as a size. As the alkali employed is generally ammonia, the preparation is called ammonium-albumen.

Its use in paper making is the same as that of glue, and it is adapted to surface sizing or may be introduced into the pulp and used with the resin soap.

When employed for surface sizing, the sized paper is dried and then heated to 266° Fahr., at which temperature the albuminoids become totally insoluble, so that if this paper gets wet and is then dried again it will take ink as well as before it was wet.—*Chem. Zeitung.*

Which Way do You Circle?

One generally reads that persons walking without landmarks perform a large circle and cut their old tracks again. This circling, as far as my present knowledge goes, is *to the left.*

My present theory is that in most persons the right leg is the stronger and the more forward to step over any obstacles, and hence that it slightly outwalks the left; this theory involving as further consequences that those in whom the left leg is the stronger would circle to the right, while those whose legs are of equal strength would either keep straight on, or would wander either way indifferently. I imagine this "outwalking" of one leg by the other to be similar to the manner in which a body of troops wheels to one side or the other.

In the following I use the expression "*right-legged.*" By this I mean that the right leg is that chosen to kick with, jump from, etc.

My negative evidence is as follows:

1. I myself am right-legged, and in a mist I always circle to the left. I have only come across cases similar to my own in these respects. On the other hand, my left arm has been trained (by always rowing on the bow side) to be stronger than my right for rowing purposes; and in sculling I always circle to my right side.

2. Those savages of whom I have read that they could keep a straight course without any landmark, were also represented as using both arms (and legs?) impartially.

I have given the above evidence chiefly to show how weak it is, in the hope that some of your readers will try to collect data of the following nature from any of their acquaintance who have had experience in the matter:

(*a*) To which side, if any, do they circle?

(*b*) Are they right or left armed, right or left legged; or are the two sides equally strong?

It might also be interesting to learn from boating friends if they have observed any connection between the side on which they have been accustomed to row and the side to which they circle in sculling; such connection as that indicated above.

Finally, I may suggest that more might be known on the question of the heredity of right or left sidedness; and as to whether persons are often right-armed but left-legged, etc. But it must be remembered that tendencies of this nature are often "educated out" in childhood.—*W. Larden, in Nature.*

A New Submarine Telegraph.

The Canary Islands, a Spanish possession on the west coast of Africa, are now connected with the continental telegraph system of Europe, by means of a cable extending from Cadiz to Teneriffe. The laying of this cable, which has just been inaugurated, has been undertaken by an English company—the Spanish National Submarine Telegraph Company—which obtained a concession from the Spanish Government and negotiated with the India-Rubber, Gutta-Percha, and Telegraph Works Co. for the laying of the new submarine communication.

The points telegraphically connected are Cadiz and Santa Cruz de Teneriffe, Teneriffe and Palma Island, Teneriffe and Gran Canaria, Lanzarote and Gran Canaria. On its part, the French Government has addressed itself to the English company in order to have the Spanish cable extended from Teneriffe to Saint Louis de Senegal. The distance from the latter point to the Canaries is about eight hundred nautical miles.

By the terms of the convention signed at Paris, and which has received the approbation of the two Chambers, the company is to lay this cable and operate it for twenty-five years. Communication between the frontiers of France and the point of landing of the cable in Spain will be secured by means of a direct wire that traverses the Spanish Continent and is specially set apart for such traffic. The tariff from France to St. Louis is fixed at two francs fifty centimes per word, including the charges of transit across Spain. This is a very small charge, the tariff having been up to the present four francs per word for submarine transmission from Lisbon to Saint Vincent alone.—*La Lumiere Electrique.*

Tea Bricks.

The process of making tea bricks out of the leaf and dust broken from the teas during preparation is a very primitive one. Mr. J. P. Cowles, Jr., of Foo Chow, China, sends us a specimen of his tea bricks and a sketch of the manufacture, which shows a number of Chinamen hanging to the end of a lever, which carries the mould for the bricks. With respect to the latter, he says that tea dust thus compressed is about as good as tea, while its reduced price, about 20 cents per pound, brings it within the reach of all. An additional advantage of these bricks consists in the fact that, since the air is excluded, they keep their flavor a long while, so that after a year or two they infuse nearly as well as when first pressed.

Compulsory Examination of Engineers.

The Franklin Institute of Philadelphia has been debating the question whether the examination of stationary engineers should be made compulsory. A committee of five was appointed to report, but the majority, including Messrs. Washington Jones and Coleman Sellers, Jr., were adverse to such compulsory examination, which was strongly advocated by the chairman, Mr. Nystrom.

The details for an effective system of compulsory examination and licenses undoubtedly admit of some sharp differences of opinion, but there is no doubt a strong public desire therefor, and that they should be made as comprehensive and searching as possible. With the greatly increased use of steam in places where the lives of many would be endangered by an ignorant or negligent engineer, the safeguard should certainly be sufficient to protect the public from incapacity.

A character for being sober, watchful, and attentive to duty cannot very well be given by any board of examiners, but if such board had the right to rescind a license formerly granted, for failure in these particulars, it would be to the interest of employers and the public alike to help strengthen the hands of the examiners by supplying the particulars which go to show character.

High Pressure Water Power.

At a recent meeting in this city of the American Society of Civil Engineers, a paper on "Water Power with High Pressures," by Hamilton Smith, Jr., M. Am. Soc. E. C., was read.

For the purpose of supplying water to the placer mines in California, numerous ditches were constructed on the western slope of the Sierras Nevadas, and in many cases the mines having been exhausted or abandoned, the water is now used for power for various purposes, and it is probable that as manufacturing assumes larger proportions, much of the motive power required will be obtained from these ditches, which in the aggregate would afford several hundred thousand horse power.

The problem presented has been the utilization of a small quantity of water—few of the ditches carrying more than 70 or 80 cubic feet per second with high heads ranging from 280 to 600 feet. Turbines have not given satisfactory results, because the great speed due to the high head resulted in excessive wear and tear. Partial turbines or tangential wheels had better success. In some cases large overshot wheels were built, one having a diameter of 65 feet. A wheel of a very simple form, called the "hurdy-gurdy," was introduced some twenty years ago, and has almost superseded all other hydraulic motors. It has been improved from time to time, and now gives an astonishingly high percentage of useful effects.

As at first used, the "hurdy-gurdy" was a narrow wood disk fastened to a cast iron spider frame; the faces of the large wheels being from 4 to 6 inches wide, the buckets being iron castings, and such wheels were built as large as 21 feet in diameter. These wheels cost little, required but light foundations, and when large really acted as fly wheels. There was, also, nearly entire immunity from accidents. With the flat bucket an efficiency of not more than 40 per cent could be obtained. Daubisson describes somewhat similar horizontal wheels used in the Alps, the water being led to them by steeply inclined troughs. Probably the use of a jet escaping from a pipe is a California invention.

The first improvement on these wheels was made by putting flanges on the side of the rim with curved sheet iron buckets between. Useful effects of from 35 to 45 per cent were obtained from these wheels; the best results being obtained with the use of comparatively large nozzles discharging the water.

The next important improvement was what is known as the Knight wheel, made of cast iron with curved buckets set close together, the nozzle being a narrow slip curved to fit the outer edge of the wheel, in order that the jet might strike the buckets as close as possible. An efficiency of from 54 to 65 per cent was obtained from these. The wheel known as the Collins wheel gave still more effective results, running up to an efficiency of 70 per cent. The latest so far used is known as the Pelton wheel, which has a bucket constructed so as to split the jet as it strikes the wheel, the bucket consisting of two sections of circles intersecting at the center of the wheel, and with convex surfaces presented to the jet.

Details of various experiments upon these wheels were given, showing an efficiency of from 82½ to 87 per cent, and the writer believes that with heads above 100 feet, or even less, a larger amount of work can be gotten out of water by the "hurdy-gurdy" than by any other form of wheel. Possibly water pressure engines may give as good, or even better results, but their cost is very much greater. Where a wheel is so placed that it will at times be submerged, the turbine is preferable; in other respects, however, the "hurdy-gurdy" possesses the advantage.

A description was then given of the method of using water power for drilling the North Bloomfield tunnel in California, which was accomplished by the use of the "hurdy-gurdy" wheel. The water was carried by a pipe main of single riveted sheet iron, No. 14 gauge, in lengths of 20 feet, put together stovepipe fashion, with the joints made tight by tarred cloth strips and pine wedges, the diameter of the pipe being 15 inches at the penstock, diminishing to 7 inches at the lower end. The aggregate length of the main and branches was about 10,000 feet. The pipe was laid on the surface of the ground, the range of temperature being from 10 degrees to 107 Fahrenheit in the shade. Both the pumping and the working of the diamond drills were done by the use of the "hurdy-gurdy" wheel. The head of water here averaged from 280 to 550 feet.

Descriptions were also given of the water power in use at the Idaho gold mines in California, where the supply main is of wrought iron 22 inches in diameter, 8,700 feet long. The pipe is placed in a bath of boiling coal tar and asphalt before laying. This pipe is double riveted and has riveted joints, the head being about 525 feet. Seven "hurdy-gurdy" wheels are employed driving air compressors, pumps, hoists, and stamp mill. The power is transmitted by Manila rope at high speed.

The writer also referred to the wrought iron pipe used for the water supply of San Francisco, which had been laid for a number of years, and seemed now to be in perfectly good order and without tubercles.

A Prize for Electricians.

The Italian Government has determined to offer, on the occasion of opening the Turin Exhibition, a prize of 10,000 francs for the most practical process for the transmission of electricity.

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ENGINEERING INVENTIONS.

An electric alarm for steam gauges has been patented by Messrs. Harvey Carley and Thomas McKenna, of Long Branch, N. J. The invention combines with the steam gauge with metallic binding posts, an electric switch with a binding post, an alarm bell, galvanic battery, circuit plates, etc., so that any increase or decrease of steam beyond certain fixed limits may be signaled at a distant place or office.

A revolving cylinder engine has been patented by Mr. John J. Blair, of Tacoma, Washington Territory. The steam and exhaust passages are formed in the shaft, which is stationary and carries swinging gates, moved in and out of the steamway in the operation of the engine, the object being to have as little reciprocating motion as possible, so reducing friction and obtaining a perfect balance, that the engine may be run at a high speed without vibration.

An ore drier and separator has been patented by Mr. Albert Seneff, of Laramie City, Wyoming Ter. This invention covers an apparatus for slowly passing the ore down a heated shaft of a furnace, on pans or disks, with a slight shaking motion, for shaking and distributing the ore as it goes forward over a long, sloping screen, from which each grade falls separately past or through a blast of air from a blow pipe, by which the earth and other matters are blown away, the ore falling into its distinctive receptacles.

An improved apparatus for raising water has been patented by Mr. Thomas Arthur, of Bangor, Penn. It is more especially for use in mines, and contemplates three tanks at different levels, connected by two bent tubes and a siphon, one of the tubes having a discharge siphon, and the lower tank having a pipe leading to the water to be raised, an upwardly opening valve, and a discharge pipe with an outwardly opening valve, so water can be raised by atmospheric pressure induced by water flowing through the tanks, siphon, and bent tubes.

MECHANICAL INVENTIONS.

A saw mill feed mechanism has been patented by Mr. Silas Dickson, of Marcy, Ohio. Instead of the usual toothed rack for driving the carriage, a pitch chain with sprocket wheel is used; the carriage may run each way beyond the saw, and the chain has friction rollers to facilitate its working freely on the teeth of the sprocket wheels.

A machine for planing and shaping wooden stirrup slats has been patented by Messrs. Wilber F. Cowles, of St. Mary's, and James Woolworth, of Sandusky, Ohio. It is a rotary planer, with trimming saws, and with feeding and controlling apparatus, so the slats may be received from the sawing machine, surfaced on the outside, shaped on the inside, and trimmed at the ends, suitably for being finally bent into the form in which they are finished.

AGRICULTURAL INVENTIONS.

An improved sickle bar and knife has been patented by Mr. Lorenzo Wallace, of Kansas City, Mo. The object is to provide for attaching the knives for cutters to sickle bars, so as to allow the convenient placing and removing of the knives, the sickle bar having a groove on one side with apertures in its bottom, and cross bars in combination with cutter sections, with hook-shaped lugs and a screw pin and nut.

A cotton-worm destroyer, sprinkler, etc., has been patented by Messrs. John D. Lambert, Sr., and John G. Wiggins, of Monroeville, Ala. With a pump, tank, and sprinkling devices is a three-wheeled vehicle, with side bars forming handles at a height suitable for a man to hold and guide the machine. The nozzles are so fitted to the connections that they can swing out or in, to adapt them for sprinkling two rows of plants at the same time, whether planted widely apart or close together.

MISCELLANEOUS INVENTIONS.

An improved fire escape has been patented by Mr. William Jensen, of Victoria, British Columbia. It is a simple, durable, and cheap rolling ladder escape, portable from window to window, incombustible, and is light and strong without needing side braces.

A button hook has been patented by Mr. James C. Beetle, of New Bedford, Mass. The object is to provide a hook by means of which shoes can be buttoned without requiring the person to stoop; the button hook is pivoted on the end of a handle, and in combination therewith is a spring for holding the hook at right angles to the handle.

An improved ax has been patented by Mr. Richard R. Pace, of Lineville, Ala. The invention provides for an opening in the ax body, from which a screw spindle extends downward, and is made to hold the blade of the ax firmly on the ax body, but so that the bit or blade may be removed when worn out and new ones inserted.

An improved treadle-power device is the subject of a patent issued to Mr. George A. Greene, of Taylor, Texas. It consists in so arranging a pair of treadles that the operator may stand erect and work the machine by a natural walking motion, with contrivances that also allow the power of the hands and arms to assist the legs when desired.

A boot and shoe last has been patented by Mr. William Pond, of Kansas City, Mo. The invention consists in making lasts with the outer edges of the bottoms raised, and inclined or beveled inwardly, to take the place of leather removed by the workman in beveling the edges of the insole, thus giving a better surface for work on the outer sole.

A sad iron holder has been patented by Serena M. Carnes, of New York city. This invention relates to improvements in connection with a former patent of the same patentee, and consists in attaching the clasp springs of the holder to the under side of the pad in such way that the pad will be free to open away from the handle of the iron when the hand of the user is removed, so helping to keep the holder cool.

A folding chair has been patented by Mr. Jonathan Hill, of New York city. It consists of pairs of legs crossed and pivoted together so that the seat-board projects farther to the front than usual, and the seat is locked so that it cannot move either up or down about its central pivot, and grooves or sliding connections at the back, with their objectionable friction and loss of strength, are avoided.

A sleigh-runner attachment for vehicle wheels has been patented by Mr. Frank J. Larkin, of Kenosha, Wis. A runner is shaped the same as a sleigh-runner, and two wedge-shaped pieces, having a longitudinal groove in the bottom, adapted to receive the runner, can be adjusted thereon according to the diameter of the wheel, so the runner can be adjusted to wheels of any diameter.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

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Manufacturers of requisites for machinery and factory purposes, such as belting, and India-rubber articles, especially new inventions, will please forward samples and price lists to

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"The Sweetland Chuck." See ad. p. 108.

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"How to Keep Boilers Clean." Book sent *free* by James F. Hotchkiss, 86 John St. New York.

Iron Planer, Lathe, Drill, and other machine tools of modern design. New Haven Mfg. Co., New Haven, Conn.

Pumps—Hand & Power, Boiler Pumps. The Goulds Mfg. Co., Seneca Falls, N. Y., & 15 Park Place, New York.

Fox's Corrugated Boiler Furnace, illus. p. 354. Hartmann, Le Doux & Maecker, sole agents, 134 Pearl St., N. Y.

For Freight and Passenger Elevators send to L. S. Graves & Son, Rochester, N. Y.

Best Squaring Shears, Tinners', and Canners' Tools at Niagara Stamping and Tool Company, Buffalo, N. Y.

Lathes 14 in. swing, with and without back gears and screw. J. Birkenhead, Mansfield, Mass.

The Best.—The Dueber Watch Case.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN Patent Agency, 261 Broadway, New York.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

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For Power & Economy, Alcott's Turbine, Mt. Holly, N. J.

Railway and Machine Shop Equipment. Send for Monthly Machinery List to the George Place Machinery Company, 121 Chambers and 103 Reade Streets, New York.

Wanted.—Patented articles or machinery to make and introduce. Gaynor & Fitzgerald, New Haven, Conn.

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Lightning Screw Plates, Labor-saving. Tools, p. 92.

Catalogues free.—Scientific Books, 100 pages; Electrical Books, 14 pages. E. & F. N. Spon, 35 Murray St., N. Y.

Curtis Pressure Regulator and Steam Trap. See p. 142.

Woodwork'g Mach'y. Rollstone Mach. Co. Adv., p. 141.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 142.

American Fruit Drier. Free Pamphlet. See ad., p. 158.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 20,000 Crank Shafts and 15,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

Brass & Copper in sheets, wire & blanks. See ad. p. 158.

The Improved Hydraulic Jacks. Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Friction Clutch Pulleys. D. Frisbie & Co., Phila. Pa.

Tight and Slack Barrel Machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 158.

Sewing Machines and Gun Machinery in Variety. The Pratt & Whitney Co., Hartford, Conn.

The Porter-Allen High Speed Steam Engine. Southwark Foundry & Mach. Co., 430 Washington Ave., Phil. Pa.

Special.

JUDGE FLANDERS, OF NEW YORK.

The Hon. Joseph R. Flanders enjoys the eminent distinction of being one of the most prominent lawyers in New York. Born and brought up in Malone, Franklin County, on the edge of the Adirondack region, he early devoted himself to the practice of law, and took an active part in the politics of the State. He was for years judge in Franklin County, and served with distinguished ability several terms in the Legislature of New York. He was for a long time in partnership, in the practice of law, with the Hon. W. A. Wheeler, who was Vice-President of the United States during the Presidency of Mr. Hayes. Judge Flanders was a member of the famous committee appointed about thirty years ago to revise the Constitution of the State of New York. He always has been a staunch and fearless advocate of temperance reform, and of purity in political affairs. During the controversy which led to the war, he was conspicuous for his consistent and forcible advocacy of "State rights," always taking the ground of the statesman and jurist, and not affiliating with the demagogues or noisy political charlatans on either side.

In his present appearance Judge Flanders' countenance gives no indication of the remarkable physical experience through which he has passed. No one would suppose, from seeing him busily at work in his law office, a cheerful, hearty, and well preserved elderly gentleman, that he was for many years a great sufferer, and that his emancipation from slavery to severe disease was a matter of only recent date. But even so it is. Visiting him a few days ago in his well appointed law offices in "Temple Court," which is one of the new twelve story office buildings of the Metropolis, we found him disposed to engage in conversation regarding his illness and his complete restoration to health. The information which he communicated in regard to this extraordinary case was substantially as follows:

"For many years I suffered from weak digestion and the dyspepsia consequent upon it. My health was not, at any time since I was twenty-one years of age, vigorous; although by persistence and close application I have been able in most of the years to perform a large amount of work in my profession. Gradually I declined into a state of physical and nervous prostration, in which work became almost an impossibility. In 1879 I was all run down in strength and spirits. Energy and ambition had entirely departed. That summer I went to Saratoga, and took a variety of the waters, under the direction of one of the resident physicians. But instead of receiving any benefit I grew weaker and more miserable all the time I was there.

"In September I returned to New York in a very reduced state. I was incapable of work, and hardly able to leave the house. Soon after my return I suffered a violent chill, which prostrated me to the last degree. But under medical treatment I gradually rallied, so that in the course of the winter and spring I managed to do a little work at my office in my profession. During this time, however, I was subject to frequent fits of prostration, which kept me for days and weeks at a time in the house.

"So I kept on until the summer of 1882. I tried a variety of medicaments which kind friends recommended, and was under the care of several physicians from time to time. In the latter part of the summer I went to Thousand Islands, where I staid several weeks with friends. But I found the atmosphere did not agree with me. Soon I had a chill; not a severe one, yet in my state it added to my weakness and general discomfort. Several days after this I had another chill, which totally prostrated me.

"As soon after this as I was able to travel, I went to Malone, my old Franklin County home, intending to stay for a while among relations and friends, and to consult my old family physician. But I found that he was away in the White Mountains with Vice-President Wheeler, my old friend and former law partner. They did not return to Malone until three days before I left there. Of course I consulted the physician. He neither said nor did much for me. I came away, feeling that the battle of life was nearly ended. The next time I saw Mr. Wheeler in New York, he told me that the doctor had said to him that he never expected again to see me alive. When I arrived at home in September, it was in a state of such exhaustion that I was unable to leave home except on bright and sunshiny days, and then only to walk slowly a block or two.

"Meanwhile, my son, who had been in Massachusetts, made the acquaintance of a country postmaster in that State, an elderly gentleman, whose prostration seemed to have been as great as my own, or nearly so. This gentleman had been taking the Compound Oxygen Treatment, and he had received from it the most surprising advantage. My son wrote frequently, and urged that I should try this treatment. But I had lost all faith in remedies. I had tried many things, and had no energy to try any more. But in September my son came to New York, and persuaded me to visit Dr. Turner, who is in charge of Drs. Starkey and Palen's office in New York, for the Compound Oxygen Treatment. My going there was not because I had any faith in this treatment, but to gratify my son's kind importunity. When Dr. Turner examined my case, he thought I was so far gone that he hardly dared to express the faintest hope.

"On the seventh of October I commenced taking the treatment. To my great surprise I began to feel better within a week. In a month, I improved so greatly that I was able to come to my office and do some legal work. I then came to the office regularly except in bad weather. On the nineteenth of December a law matter came into my hands. It was a complicated case, promising to give much trouble, and to required very close attention. I had no ambition to take it, for I had no confidence in my ability to attend to it. I consented, however, to advise concerning it, and to do a little work. One complication after another arose. I kept working at it all winter and into the spring. For three months this case required as continuous thought and labor as I had ever bestowed on any case in all my legal experience. Yet under the constant pressure and anxiety I grew stronger, taking Compound Oxygen all the time. In the Spring, to my astonishment, and that of my friends, I was as fit as ever for hard work and close application.

"My present health is such that I can without hardship or undue exertion attend to the business of my profession, as of old. I am regularly at my office in all kinds of weather, except the exceedingly stormy, and even then it is seldom that I am housed. My digestion is good, my sleep is as natural and easy as it ever was, and my appetite is as hearty as I could desire.

"A remarkable feature of my case is the hopelessness with which Dr. Starkey viewed it at the outset. It was not brought to his personal attention until after, in Dr. Turner's care, I had begun the treatment. Then my son wrote to him, setting forth my condition, and asking him to interest himself individually in endeavors for my benefit. Dr. Starkey replied that he had carefully examined the case, as set before him, and that there was evidently nothing that could be done. He saw no possible chance of my being made better, and doubted if I could even be made more comfortable. 'I am very sorry,' he wrote, 'to give such a hopeless prognosis, but conscientiously I can give no other.' What would Dr. Starkey have said, had he then been assured that in less than a year from the time of his writing I should be thoroughly restored to as good health as ever I had, and that I should be able to attend regularly to the arduous duties of my profession?

"Do I still continue to take the Treatment? No, not regularly, for my system is in such condition that I do not need it. Once in a while, if I happen to take cold, I resort to the Treatment for a few days, and always with certain and beneficial effect.

"My confidence in the restorative power of Compound Oxygen is complete; as also it is in the ability and integrity of Drs. Starkey and Palen, and of Dr. Turner, who is in charge of their New York Depository; otherwise I should not allow my name to be used in this connection. I have thus freely made mention of the history of my case as a duty I owe of rendering possible service to some who may be as greatly in need of physical recuperation as I was."

From the above it would seem that even the most despondent invalids and those whose condition has been supposed to be beyond remedy, may take courage and be of good cheer. For the most ample details in regard to Compound Oxygen, reference should be made to the pamphlet issued by Drs. Starkey and Palen, 1109 and 1111 Girard Street, Philadelphia. On application by mail, this pamphet will be sent to any address.

NEW BOOKS AND PUBLICATIONS.

THE CREATORS OF THE AGE OF STEEL. By W. T. Jeans. Charles Scribner's Sons, New York. Price, $1.50.

This is a volume of sketches, anecdotal and somewhat historical, but well adapted to suit the popular taste, for it touches upon the most prominent points in the lives of Sir Henry Bessemer, Sir William Siemens, Sir Joseph Whitworth, Sir John Brown, Mr. S. G. Thomas, and Mr. G. J Snelus. These are all names of men who have become known to the world since 1850, in connection with the wonderful development of the period in metallurgy, although some of them, and particularly the late Dr. Siemens, have been equally distinguished by eminently valuable researches in many other directions. The book is a particularly good one for the reading of boys engaged in any mechanical employment, its facts being such as are calculated to lighten studious labors and stimulate ambition.

BULLETIN DE LA SOCIETE INTERNATIONALE DES ELECTRICIENS, Paris: Librairie Gauthier-Villars. Price, 27 fr. per annum.

The first number of Vol. I. of this periodical contains the history of the formation of the society, its constitution and by-laws, together with a list of more than 1,200 members. As the name indicates, the society is open to all nationalities, irrespective of the occupation of the applicant; any one in any way interested in electricity may become a member. The *Bulletin* appears monthly, and will contain the proceedings of the society, together with contributions from men of science.

STEEL AND IRON. By William Henry Greenwood, F.C.S., Assoc.M.I.C.E., M.I.M.E. Cassell & Company, London and New York. 536 pp. Price $2.

This is one of a series of manuals of technology edited by Prof. Aryton, F.R.S., and R. Wormell, D.Sc., M.A. The general student and the intelligent workman will find in this volume a clear and comprehensive manual of practical information, and of the scientific principles upon which the practice rests, in the metallurgical and mechanical treatments between the iron ore and the production of the finished bar, rail, or section. The author disclaims endeavoring to compass such minute detail as would be necessary to cover all particulars of the whole range of such operations, but the vast field of practical knowledge which the title suggests has evidently been faithfully gleaned, the progress of recent years intelligently considered, and about as much well-digested information given thereon as could well be got into a treatise of such dimensions.

HISTORY OF THE UNITED STATES IN RHYME. By Robert C. Adams. D. Lothrop & Co., Boston.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at the office. Price 10 cents each.

Correspondents sending samples of minerals, etc., for examination, should be careful to distinctly mark or label their specimens so as to avoid error in their identification.

(1) C. F. P. asks for an ink that will copy well in an ordinary letter press and will not gum in a stylographic pen? A. We would recommend you to use an ink made by dissolving one part of commercial nigrosin, soluble in water, in 80 parts of water, and to this add a sufficient quantity of glycerine or sugar to produce a copying ink.

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(2) W. H. W. writes: You recently gave an interesting account of the manufacture of walking canes. Will you be kind enough to state in your next issue the mode of polishing, or rather the receipt for varnishing the canes? A. Use the following: gum shellac, 3 oz.; gum mastic, 1 oz.; gum sandarac, 3 oz.; alcohol, 40 oz. Dissolve the last two in the alcohol, then dissolve the shellac, and pour off the clear foruse.

(3) J. C. L. asks if there is any cheap way of making Prussian blue, and which is the best way? A. The following method is given in "Spons' Encyclopedia": (*a*) A solution of two parts of alum and one part of iron sulphate is made in water; a solution of potassium ferrocyanide is then acidulated with sulphuric acid, and some of the first solution is drop ped in till the precipitate falls slowly; the latter is well washed in a filter and dried. (*b*) Mix a solution of ferrous sulphate with one of potassium ferricyanide; wash and dry.

(4) A. F. asks: 1. What are the ingredients, and their exact proportions, for the silvering of glass, new process? 2. How can I successfully silver small sheets of glass by that process? 3. How are glass balls and other similar articles silvered by the same process? A. 1, 2, 3. We presume reference is made to the following process, recently published by Prof. Palmieri: When into an ammoniacal solution of silver nitrate is poured, first, a little potassium hydroxide and then a few drops of glycerine, the reduction of the silver begins at once. This action is accelerated if ether or alcohol be added to the mixture. A moderate heat and darkness are said to increase the brilliancy of the precipitate, and darkness also favors the adhesion to the mirror of the deposit. 4. Is heat necessary by the more simple process of the silvering of above named objects? A. Heat produces a better result, and the operation takes place more quickly.

(5) J. McD.—Chloride of lime is made in England chiefly by the alkali or soda ash manufacturers. The chlorine gas obtained as a by-product is used to saturate the lime. In this way they are able to produce it much less expensively than would be possible in this country, where a special plant would be necessary. The manufacture of tobacco is described in SUPPLEMENT, 196.

(6) W. C. W. asks: 1. How much space does one cubic foot of air fill when under pressure of one additional atmosphere—when under two? A. One-half cubic foot; one-third cubic foot; space occupied inversely as the pressure. 2. What per cent of water is wasted when using a hydraulic ram? A. From two-thirds to eleven-twelfths of the water will be lost, according to the height the water has to be raised.

(7) G. S. G. writes: How can I prevent a water tank situated in the tower of a wind mill from freezing? I notice that some of the Western manufacturers of mills give instructions in their catalogues for frost proofing. What is their process? A. You may protect your water tank from freezing by placing a tight cover over the top with an extra siding part of the way down from the top. Lay on the cover straw, hay, or felt, anything to keep the air from circulating at the surface of the water. If the inlet and outlet pipe is at the bottom the water stratifies in cold weather, the cold water remaining at the top while the feed and discharge is constantly going on at the bottom. Hence the top freezes first. If two pipes are used, the inlet pipe should be carried to the top of the tank, which will force a mixing of the water and lessen the liability to freeze. If ice cold water is pumped, as from rivers or creeks in winter, then the whole tank must be covered in as close as a country cellar to prevent freezing.

(8) M. F. asks if there is any leather pulp made from leather waste, how it is made, and whether anything like leather would mix with it to make grinding or polishing wheels? A. The waste from tanneries and currying shops, in the shape of fleshlings from the hide, and trimmings and skivings from partly tanned leather, are used to some extent in this way in the making of what is known as "leather board," a cheap rolled and pressed substitute for sole leather in the cheapest grades of boots and shoes, but the fiber when made into a pulp has no cohesive force to fit it for the purpose suggested. It makes rather a gelatinous tissue. The thick hide of the walrus is especially tanned and largely used for polishing wheels.

(9) M. L. D., Saratoga, asks for the process of making Russia leather, and where the materials can be obtained? A. Russia leather is made in this country substantially the same as any cowhide, calfskin, or sheep leather, allowing for the different way of finishing, but using birch bark tar to give the peculiar aroma. The process was long considered a trade secret, until about ten years ago, when Mr. Jewell, our Minister to St. Petersburg, and himself a tanner, looked into the business, and sent over the first lot of several barrels of birch bark tar to our largest sheepskin tanning firm. Since that time we have made a great deal of what is really only imitation Russia leather, for while it has the peculiar smell, it is very rare that any such leather is made here equal to the sterling quality of that which the Russians take so long a time and use so much care in making. The birch bark tar can probably be had of some of our importers trading with Russia, or possibly of one of the large sheepskin firms making the imitation Russia leather.

(10) N. J. H. says: Please state whether the bridge that spans the river Tay, in Scotland, has not given way since being finished, and let a train of cars into the river? A. A section of the original Tay bridge, 3,000 feet long, fell on the evening of Dec. 28, 1879, carrying down with it a train of passenger cars. A violent gale was blowing at the time. All on board the train were lost.

(11) W. B. M. asks: 1. What are the black crystals formed on the carbons of the Grenet battery, using solution of potassium bichromate? A. Chrome alum. 2. About what is the ratio of power between the Grenet and Grove cup battery? A. Measured in volts the Grove is 1,956, and the Grenet 1,095. The latter has been somewhat augmented lately by improvements in the bichromate solution. 3. Would that insulating substance known as "hard gelatinized fiber," in sheets one thirty-second inch thick, be suitable for insulating layers of secondary wire in an induction coil? A. It would answer, but a good quality of sheet hard rubber would probably be better. 4. In a medical induction coil, the magnetic induction of the core, as I understand it, is shut off by a tube of brass, fitted to slide over the core. How is it that the vibrator, which is operated by the magnetized core, is not also stopped? A. The tube diminishes the current induced in the secondary wire, but produces no effect on the magnetic core of the coil. 5. In a small induction coil I am able to get a shock with one of the secondary poles (I do not know which) and either of the primary poles. Where is the circuit? It seems impossible that there can be a circuit through the coil, it is so thoroughly insulated. A. There may be no metallic circuit. You can get a shock from a section of the wires without touching the other. It is the discharge of static electricity accumulated at the extremities of the secondary wire.

(12) E. F. M. writes: I have in my dwelling an iron tank and iron pipes to convey water through my house. I find iron scales constantly flowing and getting in the valves and water cocks, which causes them to leak. Please suggest a remedy. A. You do not say that your tank is painted. It should have been thoroughly painted before being used. The only way now is to clean it thoroughly and free it from scale on the inside; have it well dried. Then paint the inside with red oxide of iron (Prince's metallic paint) and boiled linseed oil only; no turpentine or other mixtures. Mix so that the paint spreads easily. Let the first coat dry well before putting the second coat on. This may take several days, unless you can open the tank to the sun and air.

(13) W. C. R. asks 1. If Portland cement will take a polish, and if impervious to water, no oil or varnish to be used in the polishing? A. The Portland cement will not take a polish without varnish or resinous filling. 2. Also, if that imitation of wood which I saw described in your paper some months ago will take a polish with water the same as stone, no oil to be applied? A. You will have to give the date or name of article in relation to imitation of wood.

(14) A. M. B. asks how the hoops of wooden pails, tubs, etc., are painted; whether they are done after putting in place or not? A. The hoops on wooden pails are painted by means of a roller charged with paint. The tubs and pails are revolved.

(15) S. P. C. asks for a simple method to prevent the reverberation of sound in a school room? A. Rough finished walls and ceiling are better than hard smooth finish. Paper hangings with dead finish or flock surface or flock figures will sometimes break the sharpness of the reverberation. Curtains hung upon the walls or windows, they can be of muslin or cheese cloth tastefully hung. Sometimes on only one side, opposite the speaker, will accomplish the purpose. In a school room large maps hung between the windows illustrating the daily teaching are both instructive and very useful as anti-reverberators. They are on sale by the school book publishers of New York and probably St. Louis.

(16) A. R. B.—Your spy glass with a level mounted above will have it no means of adjustment. You must have level arranged so that you can vary its position with the axis of the spy glass. The horizontal line is necessary, and must be placed across the field in the focus of the eye glass. As you will have no means of reversing the spy glass with accuracy for ascertaining the coincidence of alignment between the level and the glass, you will have to adjust by some observed level with another instrument. You can make a fair spirit level with a small long bottle nearly filled with alcohol and corked tightly, leaving just enough air in for a bubble; fasten it in a socket with plaster of Paris. A common carpenter's level is a very good instrument for leveling, by sighting across the top for ordinary ditches and drains.

(17) J. B. C. asks whether malleable iron can be cut with a sheet iron saw, run with a great degree of speed, and what causes it—the expansion of the saw or the friction of the air? Iron can be cut without touching the saw when still. And, also, what velocity would an 8 inch saw have to be run at? A. A wrought iron saw under high speed cuts iron or steel cold by the friction of the saw. An 8 inch saw would do very little work on iron, and would have to run 3,000 turns per minute; 24 to 36 inch saws are used for such work running from 2,000 to 3,000 turns per minute.

(18) H. G. asks: What ought to be the diameter of smoke stack, also height, for 3 boilers, 52 in. in diameter and 22 ft. long, with 5 flues in each boiler four-tenths in. and one-fifteenth in. in each? A. Forty-two to 44 in. square and 68 to 70 ft. in height, if any high buildings surround the chimney, increase the height, to 80 ft.

(19) J. A. C. asks: 1. What is the best speed to run a main line machine shop shaft, so as to use pulleys with plenty of belt surface? A. About 130 revolutions per minute. 2. Also, what is the best speed to run a main line mill shaft for sawing cord wood, plank, and trees, so as to use pulleys with plenty of belt surface? A. About 200 or 220 revolutions per minute. 3. How many revolutions per minute should a 26 in. circular saw be run, also what size belt to use for sawing oak cord wood plank? A. Fifteen hundred to 1,600 revolutions per minute. We think a 5½ in. belt would suit. 4. Also what size boiler will it take to run an engine 8 x 12 100 revolutions per minute, whether vertical or horizontal? A. A boiler with 180 ft. surface if vertical tubular or 145 ft. surface if horizontal tubular.

(20) J. H. B. asks: 1. Does the weight of a loaded wagon bear equally on the entire length of the spindles of the axles? A. Yes. 2. If the wheels of a loaded wagon with tires two inches wide be taken off and wheels with tires four inches wide substituted, will the friction or traction be increased on a hard road? A. Your question is very indefinite. If the wagon be a road engine, the traction will be increased.

(21) M. H. asks: What changes would be necessary for us to make in our furnace to use natural gas to generate steam? We have been using soft coal. Is natural gas used anywhere as fuel to generate steam? If so, how are the jets arranged under the boiler? A. There are a number of devices in use for burning gas under boilers, most of which are patented. The general principles are those of a Bunsen burner, in which a central jet is placed in a short tube so arranged that a strong blast from the central tube will draw in through small holes the gas or air from another source and force a mixture at the point of the nozzle. In some, the center blast is air under high pressure, drawing the gas around it after the manner of an injector. In others, the gas is under a pressure, as the central blast drawing air in by suction. Again, steam from the boiler is used for the center jet, drawing both gas and air by suction. These jets are multiplied to suit the conditions and requirements of the boiler, from one to six jets being used when applied through the doors with large pressure. In some the entire grate is removed and a nest of Bunsen burners put in its place, all being united in a common feed pipe with gas under five to ten pounds pressure issuing through the center tubes.

(22) M. G. writes: We think one of our refineries is mixing glucose with sugar. We wish to know how to detect glucose in a sugar mixture? A. Cane sugar has no effect on Fehling's solution, while a liquid containing glucose will throw down a red to yellowish precipitate of copper oxide in this reagent.

(23) J. M. D. asks: How is it possible that coffee becomes burned in the making, the kernels being kept constantly in circulation by the boiling of the water? A. It is the extract of the coffee that is in contact with the overheated tin that at first becomes baked to the tin and then burns, and makes the disagreeable flavor called burned coffee. This occurs often when coffee pots are not kept perfectly clean, or coffee is allowed to stand in the pot when not in use. A scum deposits upon the bottom which easily burns when the pot is placed on a very hot fire.

(24) C. F. P. asks: Can a "cut" of type metal be cast in a mould of plaster of Paris, so as to distinctly show the hair lines when printed, and if so, please describe process? A. The ordinary stereotype process will afford a fair copy of a cut, but an electrotype is to be preferred. You can take a stereotype mould from your cut by very carefully oiling the cut and then pouring over it a thin batter of very fine plaster of Paris. When it hardens it should be removed and dried in an oven or other equally warm place. When dry it should be lowered face up in a kettle of melted type metal and allowed to remain below the metal until bubbling ceases, when it may be carefully drawn up and allowed to cool. To secure the necessary thickness of metal the mould is surrounded by a metal frame.

(25) S. H.—Tungsten or wolfram is worth 60 to 80 cents per pound in Liverpool, and is subject to 20 per cent *ad valorem* duty. Sells here for $1 per pound. Used in making musket steel, the hardest steel made.

(26) H. W. asks: How is the gilt label or title on the back of a book made? Theoretically, I know how it is done—burned into the leather, etc.; but what I want to get at is—what is used in the work, and what is the process? There is no bindery in our neighborhood, so I turn to you for help. A. Gilding on leather, cloth, and other book binding material is similar to sign gilding, except that heat is applied. A size is used, the ordinary gold leaf is applied thereto, the type or engraved metal is heated and pressed against the gold leaf upon the book cover, and the gold remains in the letters or where the pressure was made. The surplus gold leaf is then brushed away.

(27) E. H. R. asks: What is the difference between coke and charcoal tin, and how are they manufactured? A. The difference is in the quality of the iron—charcoal iron making the best tin—it is tougher and easier worked. The tinning is done by dipping the sheets in melted tin.

(28) Mrs. J. L. H. asks: 1. For a recipe for making sirups to use in medicines, as sirup of rhubarb? A. Sirup of rhubarb may be prepared by macerating 6 ounces bruised rhubarb in 4 ounces dilute alcohol; press and filter, and evaporate to 2 pints. Mix 6 fluid ounces of this tincture with 28 fluid ounces simpl sirup. For further details consult the U. S. Dispensatory. 2. Would like information of silk culture from cocoons? A. Some information on this subject is given on page 1707, of SCIENTIFIC AMERICAN SUPPLEMENT, 107, and further in great detail in SCIENTIFIC AMERICAN SUPPLEMENTS, 174 and 175.

(29) J. M. O'M. writes: I have a very valuable meerschaum pipe which I have failed to color by smoking; please let me know through the medium of your valuable paper of an artificial or other way to color it. A. Ordinarily the pipe is boiled for coloring in a preparation of wax which is absorbed, and a thin coating of wax is held on the surface of the pipe, and made to take a high polish. Under the wax is retained the oil of tobacco, which is absorbed by the pipe, and its hue grows darker in proportion to the tobacco used. A meerschaum pipe at first should be smoked very slowly, and before a second bowlful is lighted the pipe should cool off. This is to keep the wax as far up on the bowl as possible, and rapid smoking will overheat, driving the wax off and leaving the pipe dry and raw. A new pipe should never be smoked out doors in extremely cold weather.

(30) W. T. B. asks: Where is the largest steam engine in existence? A. We think it is the Pilgrim's engine, 110 in. cylinder, 14 ft. stroke, the largest, single cylinder engine; but the double engines of the large Atlantic steamers have more power.

(31) J. A. H. asks: Can you inform me of a method of marking a steel tape with acids so that the figure so marked will show bright against the dark steel? A. Melt ordinary beeswax and tallow equal parts, or better beeswax 2 parts and Venice turpentine 1 part, and coat the steel with it where you wish the letters to appear, using it as a paint with a camel's hair brush to form the letters. Immerse the steel in a bath of sulphuric acid 1 part, nitric acid 1 part, water 2 parts by measure, for ten minutes or even less. The progress may be noted by taking from the bath and immersing in clear water.

(32) N. S. H. asks: 1. For the composition used for impression paper? A. Impression paper is prepared by mixing lampblack with cold lard to the consistency of thick cream, and applied to the paper with a rag. Then take a flannel rag and rub until all the color ceases coming off. 2. The receipt for the composition that is put on illuminating watch boxes? A. For the preparation of a luminous paint see SCIENTIFIC AMERICAN SUPPLEMENT. No. 249. 3. Also a receipt for making liquid glue? A. See back numbers of SCIENTIFIC AMERICAN.

(33) M. N. W.—The method of making cast iron malleable is briefly as follows: "White" or brittle iron is used for the castings. When the castings are cleaned from the moulding sand, they are packed in cast iron boxes with sides and bottoms three-quarters of an inch thick, with powdered sal ammoniac and forge scales, put in an oven, and kept at a red heat from six to eight days, according to the size of the castings. They must cool gradually.

(34) E. A. J. asks: If corn meal will cause a locomotive boiler to foam? A. If put in in any quantity it will cause foaming for a time, but gradually wear off.

(35) C. E. McC. asks for a receipt for painting or staining a checker board on marble top table. Something that will not spread or wash out. A. In staining marble it is necessary to heat it hot, but not so hot as to injure it, the proper heat being that at which the colors nearly boil. Blue is produced with an alkaline indigo dye. Red by dragon's blood in alcohol. Yellow by gamboge in alcohol. Gold color with (sal ammoniac) ammonium chloride, zinc sulphate, and verdigris, equal parts. Green, sap green in alcoholic potassium hydroxide. Brown, tincture of logwood. Crimson by a solution of alkanet root in turpentine. Black spots may be produced with silver nitrate. As a general rule, however, we believe these tables are made by inlaying rather than by staining.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

R. C. P.—The specimen is ordinary clay. It would have no value in New York on account of the iron it contains, but you might find some local demand for it. —D. M. D.—No. 1 consists of decomposed or oxidized sulphides of iron; the taste is due to the sulphur. No. 2 is an iron ore consisting of oxides and sulphides. No. 3 is the magnetic oxide of iron, or magnetite. No. 4 is a sample of clay too gritty for polishing purposes.—M. S. —It is impossible to form any opinion in regard to No. 1 unless it is chemically examined, the expense of which would be $5.00. No. 2 is a decomposed shale rock of no use or value.

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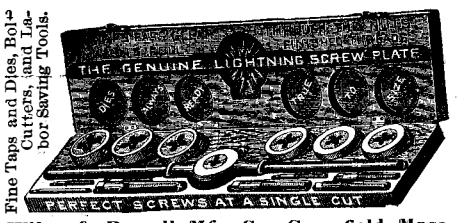

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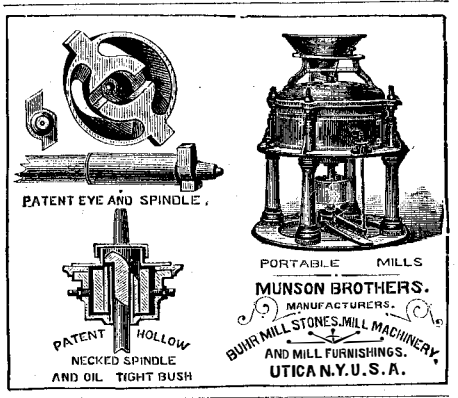

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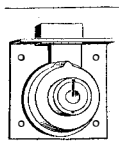
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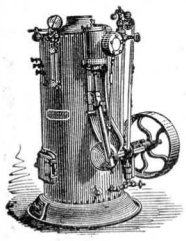

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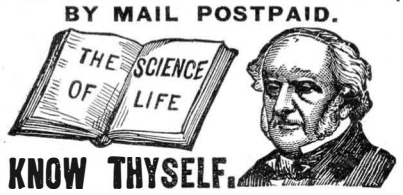

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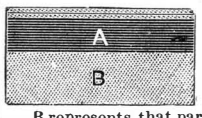

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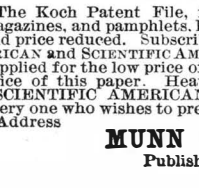

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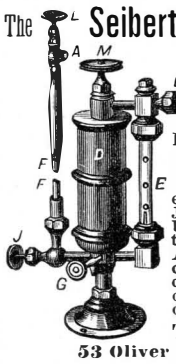

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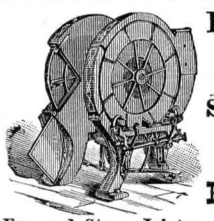

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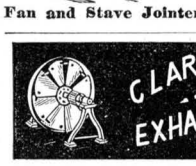

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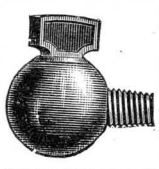

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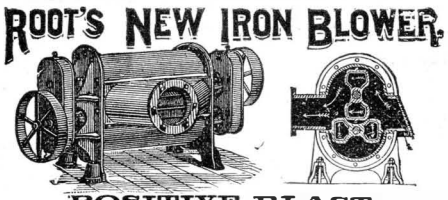

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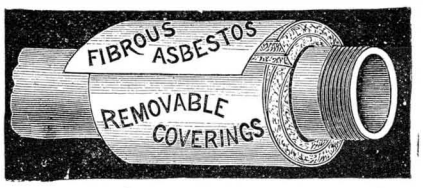

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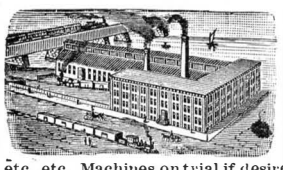

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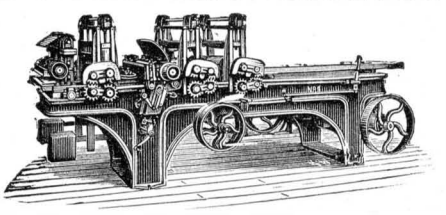

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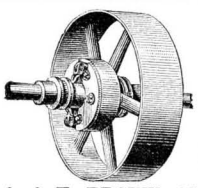

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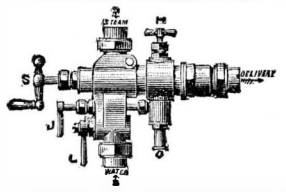

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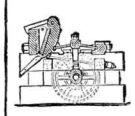

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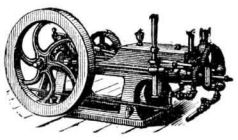

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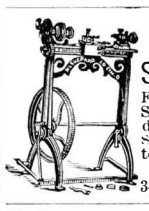

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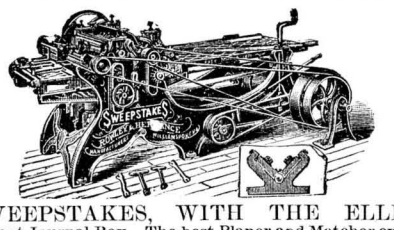

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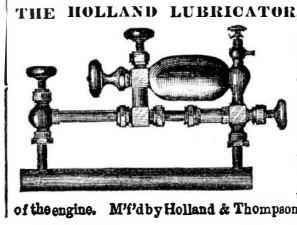

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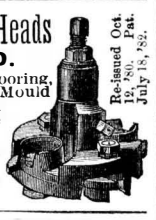

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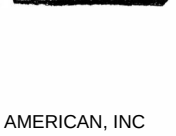

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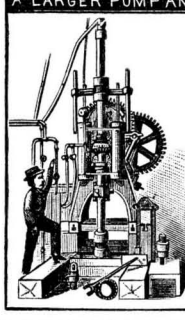

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